The MINING CONGRESS JOURNAL

Volume 16 DECEMBER, 1930 No. 12

PRESENTING

Stabilized Mineral Production
The American Mining Congress and the Industry
Government's Contribution to Mining
The Anthracite Industry Today
What's Ahead in Coal Production
Economic Future of the South's Minerals
Opportunities for the Young Engineer
Developing Standards for Metal Mines
Fulfillment of a Program for Coal
Federal Legislation for the Mining Industry

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Roof Action in New Mining Systems
Mine Ventilation
Problems of a State Mine Inspector
Use and Value of Air Analysis
A Modern Coal Washing Plant

▲ ▲ ▲

Long Hole Prospect Drilling
Management's Responsibility to Industry
A Sandstone Copper Deposit
Determining Results With Selective Flotation

Contributors

Robert E. Tally, Louis S. Cates, Scott Turner, Noah H. Swayne, John B. Dilworth, R. M. Watt, E. A. Holbrook, Lucien Eaton, J. M. Hadley, Tasker L. Oddie, G. B. Southward, L. W. Huber, W. B. Hillhouse, Walter H. Glasgow, A. U. Miller, J. W. Wilson, Moses Brown, Jr., W. V. DeCamp, I. J. Stauber, Ira L. Wright.

3,784,899 TONS	2,702,731 TONS	1,386,950 TONS	2,260,627 TONS

TOTAL 10,135,207 TONS

without a single fatality.

Another Notable Record of Safe Operation ▲ ▲ ▲ ▲

THE following is quoted from a letter written to one of our representatives by the Vice-President and General Manager of a large bituminous coal mining company—the name of which will be furnished on request.

"The record for all of our mines during the past seven years shows that we have produced, 1,100,000 tons of coal per fatality. Mine No. 1 has produced 3,784,899 tons up to January 1st, 1930 without a fatality. Mine No. 2 has produced 2,702,731 tons, Mine No. 3, 1,386,950 tons and Mine No. 4, 2,260,627 tons without a fatality."

It is significant that this company used more than 450,000 feet of Ensign-Bickford Safety Fuse during the year 1929.

Do Not "Short Fuse" --Fuse should be cut long enough for the end to extend well out of the mouth of the bore hole when the primer cartridge is in place.

All holes should be well tamped.

THE ENSIGN-BICKFORD CO.

SIMSBURY CONNECTICUT

Princeton Mining Company's *New* Kings Mine Tipple at PRINCETON, INDIANA

The Princeton Mining Company's 600 ton per hour, all steel Kings Mine Tipple is one of the newest RandS installations.

Modern in every respect, this five-track installation employs the latest in equipment design. Tipple is equipped with dump chute and five-ton weigh basket, rock chute being by-passed to rock bin. Coal passes into reciprocating feeder hopper after weighing and is discharged onto a Marcus Screen.

The 13'6" wide Marcus Picking Table Screen handles run of mine to two side picking wings. All sizes are hand picked except No. 2 Nut and Slack. Five sizes are prepared — 6" Lump, 3" x 6" Egg, 3" x 2" No. 1 Nut, 2" x 1¼" No. 2 Nut and 1¼" Slack. Bone coal is handled through a Bradford Breaker, refuse being delivered to the gob pile and coal re-cleaned over a Menzies Hydro-Separator after which it is rescreened over the Marcus Picking Table.

Arrangement allows for slack delivery to the boiler room conveyor and any or all sizes of coal to be delivered to the local trade bin.

High efficiency and proper preparing and handling are accomplished with RandS engineering, and the application of RandS equipment.

RS AND COMPANY

ROBERTS AND SCHAEFER CO.

ENGINEERS and CONTRACTORS

PITTSBURGH, PA., 418 OLIVER BLDG. WRIGLEY BUILDING, CHICAGO HUNTINGTON, W. VIRGINA, 514 NINTH AVE.

THE MINING CONGRESS JOURNAL

VOLUME 16 DECEMBER, 1930 No. 12

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Practical Operating Men's Department

COAL

Mine Ventilation
Problems of State Mine Inspector
Use and Value of Air Analysis
A Modern Coal Washing Plant

METAL

Long Hole Prospect Drilling at the Ray Mines
A Sandstone Copper Deposit
Management in Its Responsibility to Industry
Determining Selective Flotation Mill Results

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Sampling a melt of Roebling Acid Steel *for laboratory check*

WATCH the open-hearth furnaces in the Roebling steel mill and you will see the pictured procedure repeated time and time again. It is sampling the melt for a chemical check in the laboratory.

Wire Rope can be no better than the steel of which it is made. For Roebling "Blue Center" Steel Wire Rope the acid steel must measure up to exceedingly high standards. Its quality is closely controlled in small open hearth furnaces, and it is repeatedly subjected to a careful chemical check.

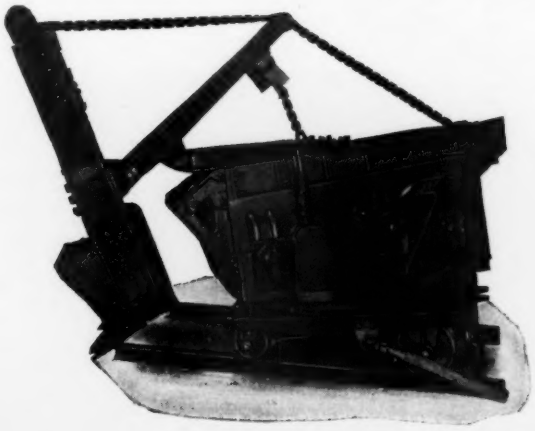
Hundreds of thousands of feet of Roebling "Blue Center" Steel Wire Rope are produced yearly by the most modern of production methods. But it is old-fashioned thoroughness that protects its quality every step of the way.

JOHN A. ROEBLING'S SONS COMPANY

WIRE · WIRE ROPE · WELDING WIRE · FLAT WIRE
COPPER AND INSULATED WIRES AND CABLES
TRENTON, N. J. *Branches in Principal Cities*

ROEBLING "BLUE CENTER" STEEL **WIRE ROPE**

Development Costs go down!



IN reopening a western metal mine, an existing adit four by seven feet in size was enlarged to eight by eight feet. Drilling and blasting was done on two shifts.

On the third shift mucking was done with a Hoar Shovel. Average advance was thirty-five feet per day.

The mucking crew consisted of three men — shovel runner, helper, and motorman.

In addition to mucking the thirty-five foot advance in the eight hour shift, this crew laid new track and extended the pipe lines.

Other Allis-Chalmers products include machinery for Complete Mining, Metallurgical, Crushing, Screening, Washing, and Timber Preserving Plants. Electric Motors, Texrope Drives, Centrifugal Pumps, Hoists and Tractors.

DEVELOPMENT costs can be reduced, and development speed increased by the use of Hoar Shovels. For twelve years Hoar Shovels have been successfully used in development work in metallic, non-metallic and coal mines; as well as in the more severe work of hydro-electric, water, subway and railway tunnels.

Write for detailed information.

ALLIS-CHALMERS

Allis-Chalmers Manufacturing Company, Milwaukee

"Sure it's a Cinch" to Move the 44-C

BILL: I never handled a machine that hugged the track like this one; I guess it is on account of the two trucks, both of them having a king-pin.

SKINNY: She sure will twist around short curves an' any place where you can take a pit car.

BILL: I never saw any machine that would get around on that rotten track up on the south end, but it don't seem to bother us much; she twists right around it.

SKINNY: Talkin' about twistin' did you hear about Pete McGillicuddy, that big Mick over on the sixth right?

BILL: No—what happened to him.

SKINNY: Well, his buddy, that bird Ratcheeseki, threw a big party las' night, celebratin' his tenth birthday—

BILL: His tenth birthday, why you're crazy with the heat, that bird is nearly as old as I am.

SKINNY: Well, the poor goof was born on the 29th of February, so he only has a birthday every four years, an' when he does have one, believe me, he celebrates some.

As I started to say, Pete, he stayed wit' the party until the home brew was all gone, an' when he got away from there he was somewhat squiffed an' didn't know just edzactly what he was doin', so he got his overalls on back side foremost an' never knowed it.

He was lammin' it down the entry when a small piece of slate fell down from the roof an' just touched his shoulder. He got skeered an' set down, an' when I ran an' ast him if he was hurted bad, he looked down an' saw the seat of his overalls a starin' him in the face, an' he said "I ain't kilt, but I'm terrible twisted."

Bulletin 503-C completely describes the 44-C Loader. Send for your copy.

The Jeffrey Manufacturing Company

958-99 North Fourth St., Columbus, Ohio

BRANCH OFFICES:

New York, Chicago, Philadelphia, Pittsburgh, Scranton, Pa., Charleston, W. Va., Birmingham, Denver, Salt Lake City

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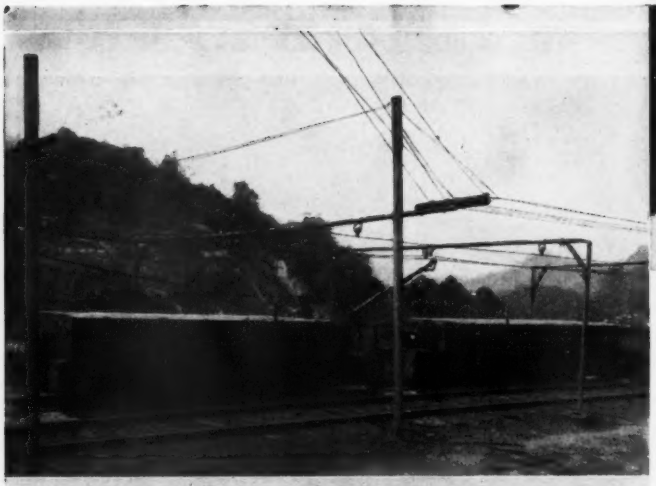
JEFFREY MFG. CO., LTD., OF CANADA: Head Office and Works, Montreal; Branch Office, Toronto; Service Station, 210 Ninth Ave., W., Calgary.

JEFFREY COAL MINE EQUIPMENT



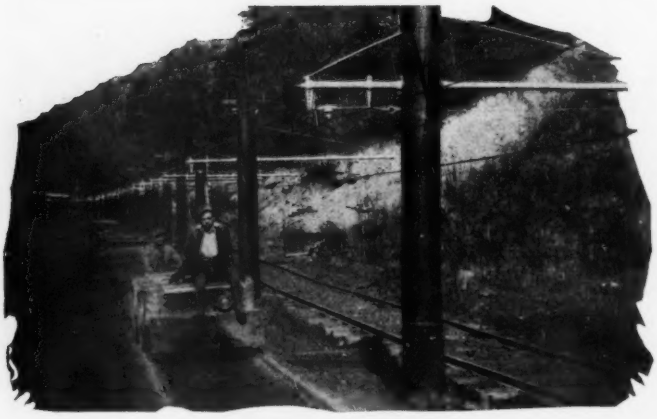
Tandem operation at a world-famous mining property. Current is collected with a special shoe and harp of the new Universal type as shown on the opposite page.

KEEPING from

EXPERIENCE shows that a continuous flow of coal from face to tipple does much toward cutting the cost per ton of production. When wheels are kept turning, the utmost is had from men and machines—more coal is mined per man-hour with no increased investment in men and machines. It naturally follows that tonnage goes over the tipple at a lower cost per ton leaving a greater net profit. But when electrical failures penalize equipment and mine-sections, mining at the greatest profit becomes impossible. Tonnage is reduced. Fixed charges are still the same. So costs go up. These delays, these production stoppages, are appropriately phrased, "dollars waiting on dimes"; because they usually result from the failure of some small device, the cost of which becomes insignificant when compared with the cost of damage done.

Profit-minded men find that electric haulage items cost so little to purchase, yet cost so much should they fail, that the best insurance against these production stoppages is to use only the best haulage materials. The soundness of this buying policy is becoming more and more widely recognized each day. Each day shows an increasing trend to change over to "O-B", because "best" and "O-B" mean one and the same thing.

Ohio Brass Company, Mansfield, Ohio
Canadian Ohio Brass Co., Limited
Niagara Falls, Canada
1330M



An excellent example of trouble-proof haulageway construction. O-B Materials were used to make certain "dollars would not wait on dimes".

Hundreds of coal companies, large and small, find O-B Materials the most economical to buy. A few:

Consolidation Coal Co.	*Harlan Fuel Co.*
Bird Coal Co.	*Meehan Coal Co.*
Old Ben Coal Corp.	*Ocean Coal Co.*

O-B Safety Switches make disconnecting loaded switches a safe operation in this efficient mine.

DOLLARS *waiting on* DIMES

Reduce Wire-Jumping With This New Harp

Here is a harp built especially for locomotive operation in low-seam coal. The seam may be so low that the trolley pole will be in a position almost horizontal; yet the new O-B Universal Harp will follow each clamp, each curve, each frog, with smoothness and sureness. It will also work well in high-seam coal where the trolley wire is as high as six-feet from the rail. That is why it is termed "Universal". The Universal Harp is made in styles for wheel or shoe collection. The angle of the Universal Harp is slight, permitting the harp to work without placing stress upon the bearings or current collector.

Is your coal low? Is it high? If wire-jumping is to be held to a minimum; if longer wear and fewer harp replacements are what is sought; this new Universal Harp is a very wise choice.

Prevent Burned Hands and Faces With This Switch

A hiss; a blinding flash; molten copper spattering over hands and face —these are too frequently the dangers of disconnecting a heavily loaded d. c. circuit with the old-style, open-type switch. Sometimes the result is even more disastrous.

O-B has designed a safety switch which successfully protects both the operator and switch when the switch is opened under load. This new O-B Safety Switch has a quick-make, quick-break feature. Full opening and full closing are always assured. The switch mechanism is fully enclosed in an insulated, fire-proof case. A magnetic blow-out coil snuffs out the arc.

Wouldn't fewer switch burn-outs, fewer burned hands and faces, be a very desirable result to strive for? Then why not investigate this O-B Safety Switch?

A Heft—a Ring and the Decision is Made!

Trolley Wheels get a tremendous amount of wear. Fast rolling contact, irregular wire and uneven pressures are severe on wheels. It takes a "he" wheel to stand the gaff in mines.

That is why most mines use O-B wheels. As soon as you "get the feel" of an O-B wheel, you know instinctively it is a real wheel in your hand. Notice how a heavy section of metal reinforces the groove where wear is the heaviest. Pick up a spike and strike the edge of the wheel—listen to that ring! When bronze rings clear as a bell, like O-B bronze, you know it is good bronze—homogeneous and free from defects. The design—the mixture of metal—these are the differences which spell success or failure to trolley wheels as cost reducers. And O-B wheels are different. They ask no favors—no quarter. All they ask is a trial in your service.

O-B Universal Harp
Finished in red Duco; a pleasing appearance; a sign that the harp is "hot" when on the trolley. See pages 40-42, O-B New Products Supplement No. 4.

O-B Safety Switch
A heavy rubber handle fully protects the operator. Will last indefinitely with few or no replacement of parts. Listed page 29, O-B New Products Supplement No. 4.

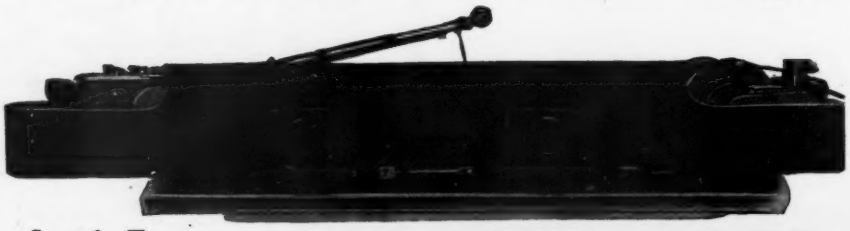
O-B Trolley Wheel
Made in 4, 5, and 6-inch sizes. A tough wheel for the tough job. Listed page 515, O-B Catalog No. 20; and page 35, O-B New Products Supplement No. 4.

Ohio Brass Co.

NEW YORK PITTSBURGH PHILADELPHIA BOSTON CHICAGO CLEVELAND ST. LOUIS ATLANTA DALLAS LOS ANGELES SAN FRANCISCO SEATTLE

PORCELAIN INSULATORS
LINE MATERIALS
RAIL BONDS
CAR EQUIPMENT
MINING MATERIALS
VALVES

The Goodman Line of Modern Low Vein Equipment



Outside Frame

Two Motors
Slow or Standard Speed
Electric Cable Reel

Book H-302

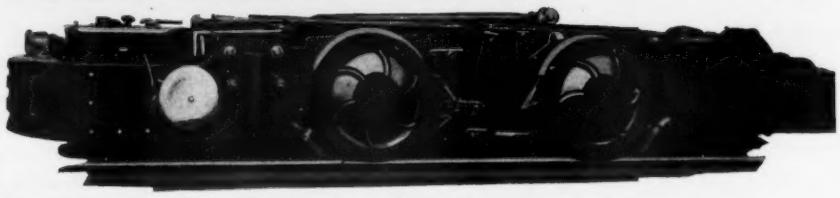
24in.Low

Inside Frame

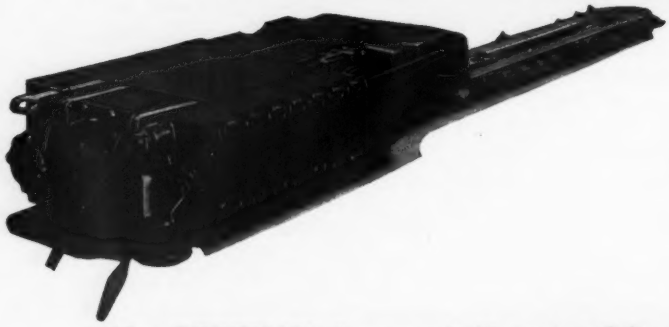
Two Motors
Slow or Standard Speed
Electric Cable Reel

Book H-302

24 in. Low



The NEW 6-Ton Low Vein Gathering Locomotives



Controls Conveniently Placed

Cuts Flush with Bottom

Both Head and Tail Rope Drums are Power Driven and Equipped with Brakes. Each Drum has Two Speeds and Both Speeds are Variable.

Book M-301

16 in. Low

The NEW Universal Control Low Vein Shortwall

Undercuts Directly from the Track

Self-Contained

Self-Propelled

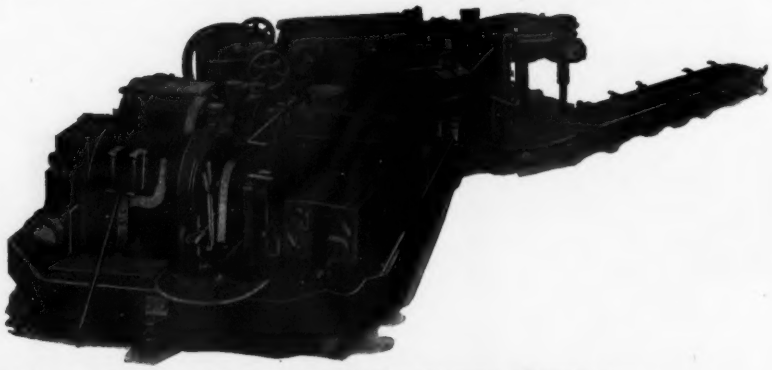
Cutting Heights [bottom of kerf] 8 in. below to 5 in. above rail tops.

Cutting Widths [standard 7-ft. cutter arm] 10 to 28 ft.

Book M-292

RUGGED—SAFE—POWERFUL

29½ in. Low



The NEW Low Vein Mounted Bottom Cutter

Every Piece Especially Designed to Meet Low Height Conditions

GOODMAN MANUFACTURING COMPANY
HALSTED ST. at 48TH.
CHICAGO - - - ILL.

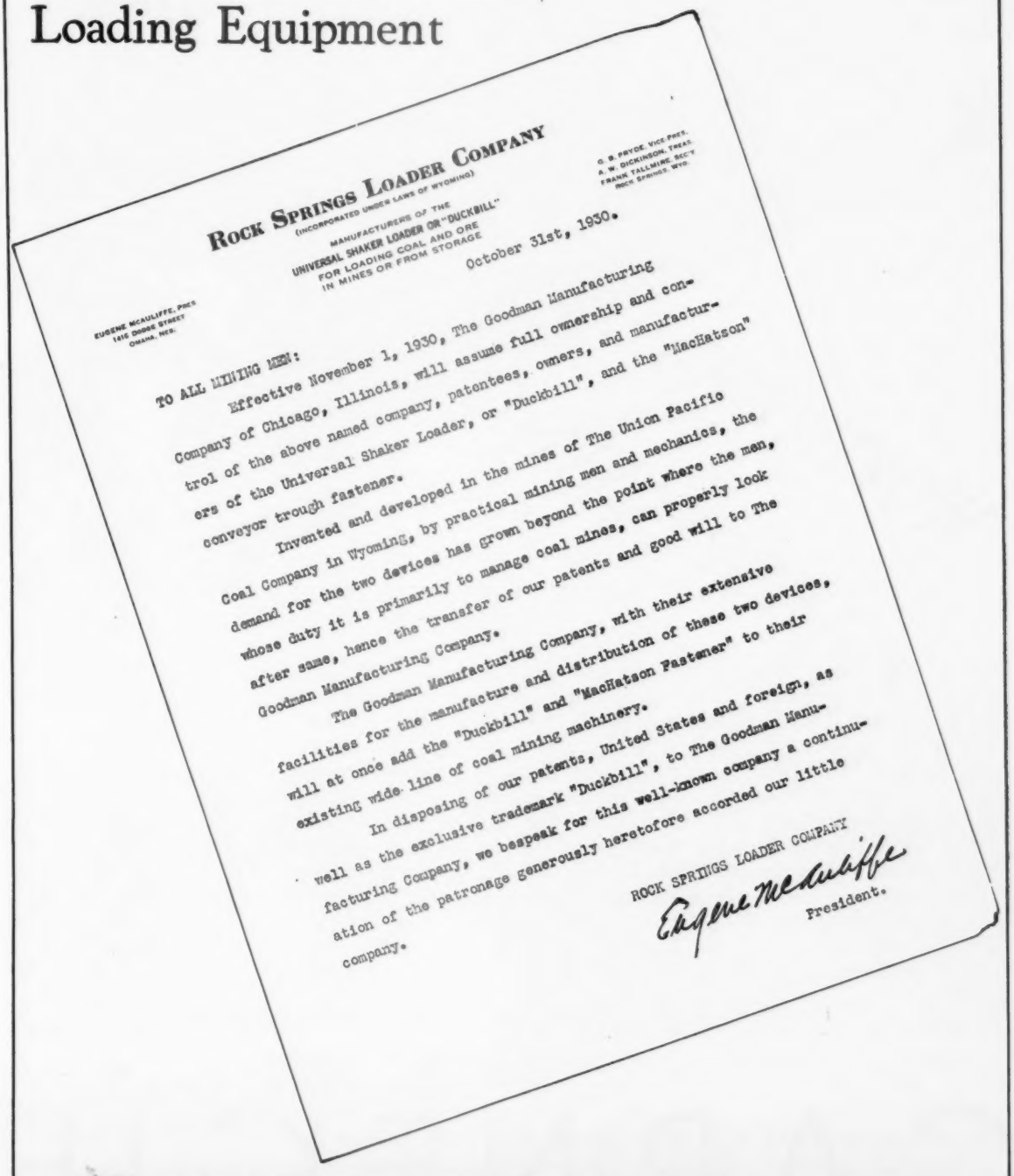
Locomotives - Loaders - Coal Cutters

PITTSBURGH-WILKES-BARRE-HUNTINGTON, W.VA.-CINCINNATI-BIRMINGHAM-ST. LOUIS-DENVER-PRICE, UTAH

(42)

We Now Add "Duckbill"

To the Goodman Line of Loading Equipment



ROCK SPRINGS LOADER COMPANY
(INCORPORATED UNDER LAWS OF WYOMING)
MANUFACTURERS OF THE
UNIVERSAL SHAKER LOADER OR "DUCKBILL"
FOR LOADING COAL AND ORE
IN MINES OR FROM STORAGE

EUGENE McAULIFFE, PRES.
1415 DODGE STREET
OMAHA, NEB.

O. B. PRYDE, VICE PRES.
A. W. DICKINSON, TREAS.
FRANK TALLMIRE, SEC'Y
ROCK SPRINGS, WYO.

October 31st, 1930.

TO ALL MINING MEN:

Effective November 1, 1930, The Goodman Manufacturing Company of Chicago, Illinois, will assume full ownership and control of the above named company, patentees, owners, and manufacturers of the Universal Shaker Loader, or "Duckbill", and the "MacHatson" conveyor trough fastener.

Invented and developed in the mines of The Union Pacific Coal Company in Wyoming, by practical mining men and mechanics, the demand for the two devices has grown beyond the point where the men, whose duty it is primarily to manage coal mines, can properly look after same, hence the transfer of our patents and good will to The Goodman Manufacturing Company.

The Goodman Manufacturing Company, with their extensive facilities for the manufacture and distribution of these two devices, will at once add the "Duckbill" and "MacHatson Fastener" to their existing wide line of coal mining machinery.

In disposing of our patents, United States and foreign, as well as the exclusive trademark "Duckbill", to The Goodman Manufacturing Company, we bespeak for this well-known company a continuation of the patronage generously heretofore accorded our little company.

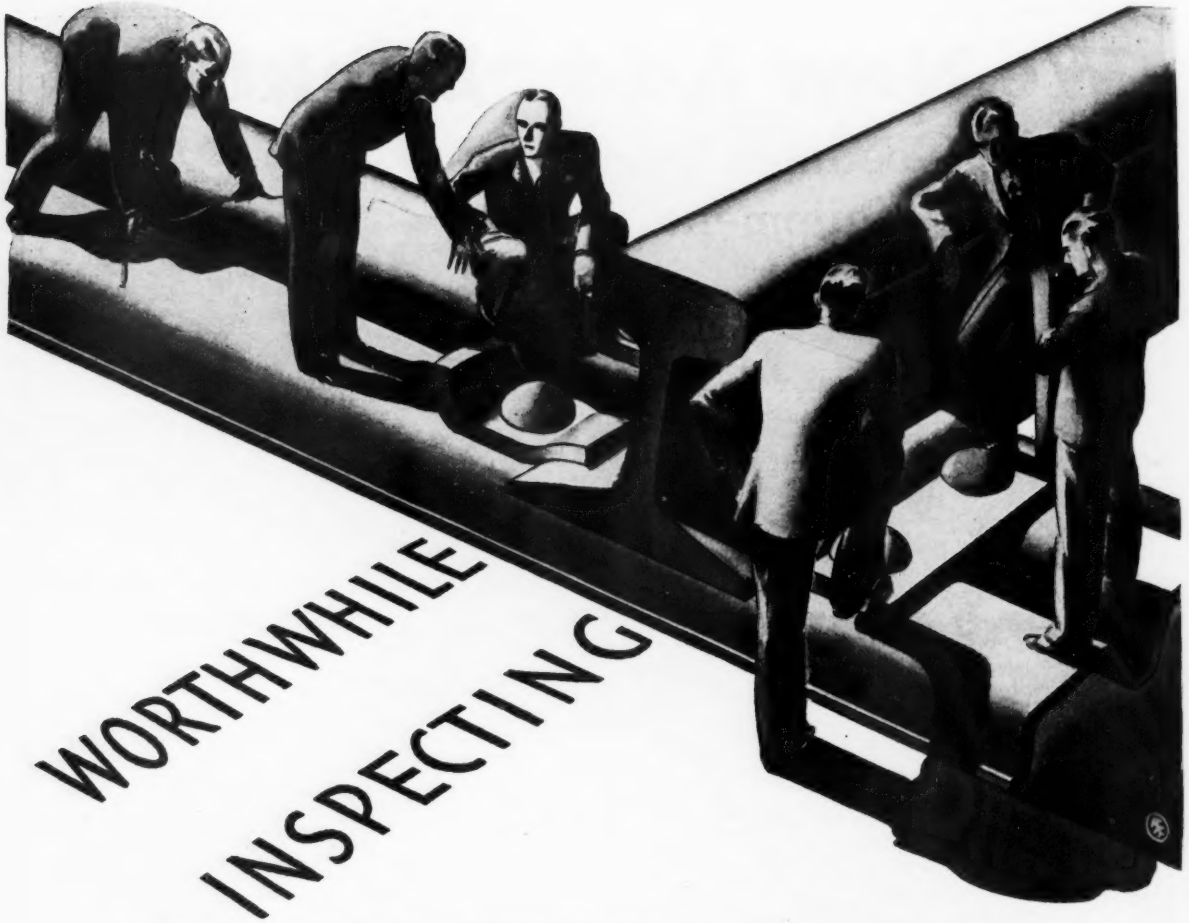
ROCK SPRINGS LOADER COMPANY
Eugene McAuliffe
President.

GOODMAN MANUFACTURING COMPANY

HALSTED ST. at 48TH.
CHICAGO - - - ILL.

Locomotives - Loaders - Coal Cutters

PITTSBURGH-WILKES-BARRE-HUNTINGTON, W.VA.-CINCINNATI-BIRMINGHAM-ST. LOUIS-DENVER-PRICE, UTAH



THOSE interested in efficient and economical track construction will find Carnegie Copper Steel Mine Ties worthy of their attention. Pictured above is one of the many popular Carnegie sections available. Note its sturdy construction—the broad foot, the wide bearing surface and center groove, which tend to prevent the tie from sinking into soft bottom. This section is light and strong, and its shallow depth recommends its use in low seams of coal. The outside fastening is securely riveted to the tie. Double inside clips clinch the rail, insuring true-to-gauge construction. No special tools or fittings are necessary in laying the tie. A hammer blow locks the clips.

Carnegie Copper Steel Mine Ties are efficient tools of modern mining. They are rust-resistant, thus assuring a much longer life than ordinary steel ties can give. Literature, descriptive of the entire line, will be sent at your request.

CARNEGIE STEEL COMPANY - PITTSBURGH, PA.

Subsidiary of United States Steel Corporation

87

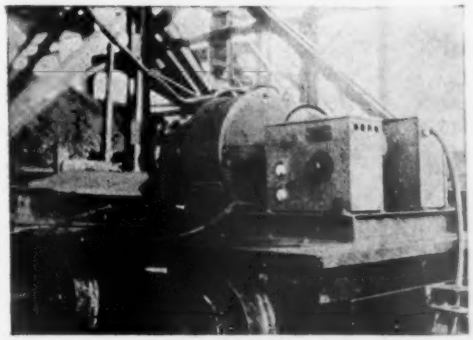
CARNEGIE
COPPER STEEL MINE TIES

Wherever the track leads . . . . *FlexArc* Welding is available

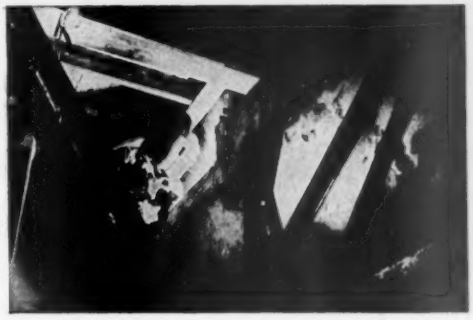
A RECLAMATION or repair job in the shop—or a construction job in the mill is all the same to this Westinghouse FlexArc Welder, mounted on a mine car. Its money-saving and production-insuring qualities extend to the limits of the mine property, within cable distance of the tracks.

And FlexArc welding is noted for its ease of application—regardless of where it is used. By eliminating the causes of electrode sticking, FlexArc has converted minutes of arc-fighting into minutes of skillful bead-laying. This increased welding speed and neat results add value to the maintenance dollar.

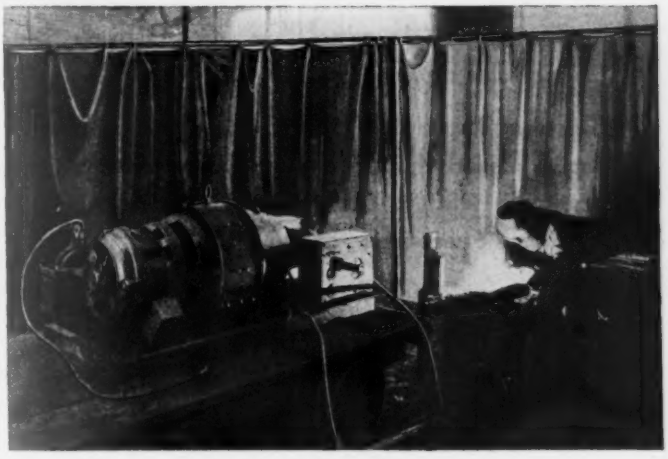
Write to our nearest office for complete information on FlexArc Welders and FlexArc Electrodes.



The FlexArc Welder on its mine car.



Fabricating an air duct in the mill.



Reclaiming worn locomotive axle collars in the shop with the mobile FlexArc Welder.

Service, prompt and efficient, by a coast-to-coast chain of well-equipped shops

Westinghouse

T 31569

TUNE IN THE WESTINGHOUSE SALUTE OVER THE N. B. C. NATION-WIDE NETWORK EVERY TUESDAY EVENING.

A SIMPLIFIED LIST OF MODERN PERMISSIBLES

Only 8 years ago (1922) Hercules listed 37 permissibles to meet the individual and general blasting demands of the coal mining industry. Among these were brands which could be ranked with the best available at that time for any particular condition.

Today, as a result of a development program started in 1923, we offer a list of 9 modern permissibles which cover an even greater range more completely and effectively than did the 37 powders replaced.

This remarkable simplification means that the coal mining industry need choose from only 9 permissibles, each representing a distinct advance over the 37 older types in efficiency or economy, or both.

This is an outstanding example of Hercules' untiring research and exhaustive study of field conditions to produce greater explosives values and to make the selection of explosives easier. You can select the proper permissible for your coal from the list at the right. Check the coupon-list for further information.

HERCULES POWDER COMPANY

(INCORPORATED)

Wilmington Delaware

ALLENTOWN, PA.
BIRMINGHAM
BUFFALO
CHICAGO
DENVER
DULUTH
HAZLETON, PA.
HUNTINGTON, W. VA.
JOPLIN, MO.
LOS ANGELES
NEW YORK CITY
NORRISTOWN, PA.
PITTSBURG, KAN.
PITTSBURGH, PA.
POTTSVILLE, PA.
ST. LOUIS
SALT LAKE CITY
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The Permissible For Your Coal Is In This List

☐**HERCOAL-F:** The new type lump producer. A very high cartridge count permissible (about 500)* with black powder action.

☐**HERCOAL-D:** This Hercoal lies between F and C in count (about 450),* and like them is a black powder action, lump producer.

☐**HERCOAL-C:** Another black powder action, lump producing permissible. Lower count (about 400),* and stronger per cartridge than Hercoal-F.

• • •

☐**RED H F-L. F.:** Slow and strong with a cartridge count of about 356.* A lump producer.

☐**RED H D-L. F.:** Slow and strong. Cartridge count around 316*. Another lump producer.

☐**RED H C-L. F.:** Slow and strong. About 276* count and a lump producer.

☐**RED H B-L. F.:** A fast, dense, strong permissible of about 280* count with a smashing action.

• • •

☐**COLLIER C-L. F.:** Fast and strong but with higher count (about 320)* than Red H B-L. F.

☐**HERCOGEL:** Dense and strong. Suitable for wet work. Count about 190.*

*NOTE: Cartridge counts refer to the number of 1¼" by 8" cartridges in 100 lbs. of explosives

• • •

HERCULES POWDER COMPANY
934 King Street, Wilmington, Delaware

Gentlemen: Please send me pamphlets describing the Permissible explosives checked.

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B-8

JOY

5-BU FOR HIGH COAL

7-BU FOR LOW COAL

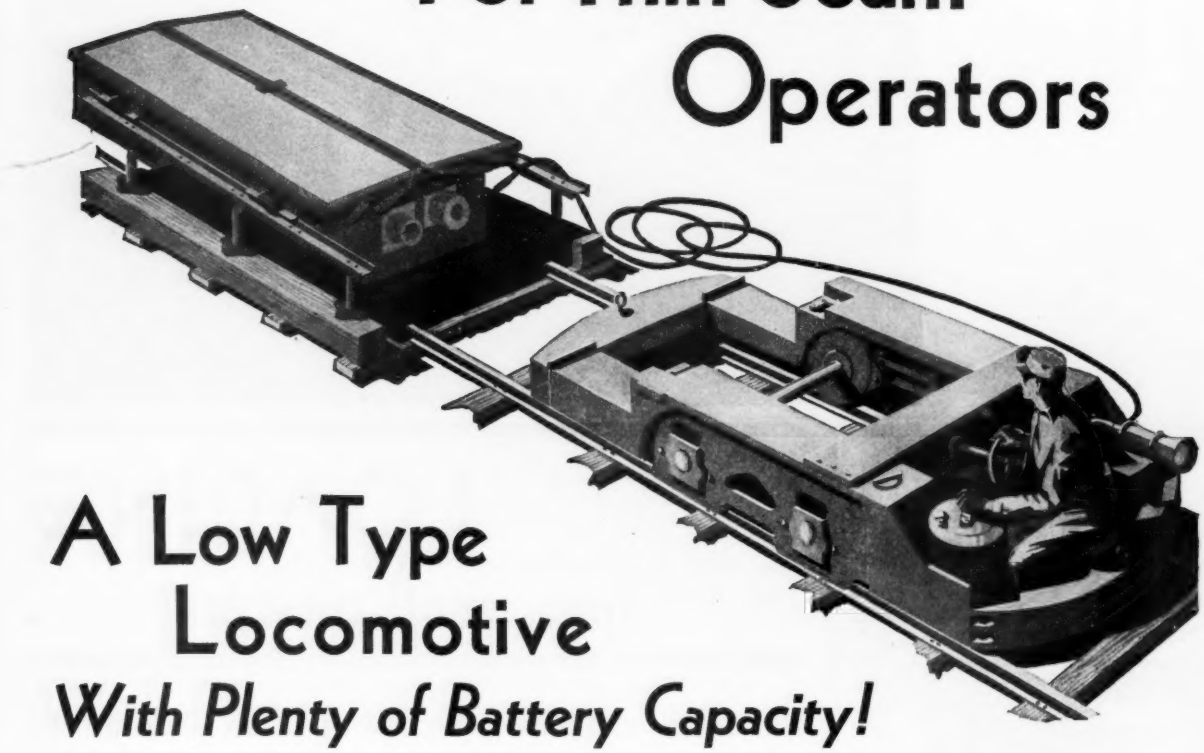
LOADING

into small pit-cars . . .

The small capacity pit-car has been a deterrent factor in mechanical loading on account of the many changes of loads for empties behind the machines. But where physical conditions permit, methods of mining and systems of transportation can be worked out to an advantage. The photograph shows an operation where one ton cars are being loaded on a circular track in wide room faces, and the average production per mechanical loader shift is being maintained at 318 tons. Our engineers will be glad to work with you in solving your loading problems. Let us estimate, without obligation on your part, the possibilities for cost reduction in your properties.

JOY MANUFACTURING CO., Franklin, Pa.

For Thin Seam Operators



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With Plenty of Battery Capacity!

Heretofore the thin seam operator was forced to use a chassis for each battery....now, with the new Telescopic Mancha Electric Mule the exhausted battery can be replaced with a fully recharged one at any time. Mancha's patented transfer rack makes this easy. All of the distinctive Mancha features are built into the new telescopic —Cast annealed steel frame (we believe this is the strongest frame ever made), heavily re-inforced removable battery box, front and rear bumpers, headlights mounted on the chassis, and plenty of room and protection for the motorman.

Mancha's New Telescopic Low Type means low cost, safe haulage for the thin seam operator. Write for bulletin that gives complete information. Mancha Storage Battery Locomotive Co., 1909 South Kingshighway, St. Louis, Mo., U. S. A.

MANCHA'S

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ELECTRIC MULE

NOW—"CHEAPER COAL"

the cry of all operators

GOOD EQUIPMENT is one of the prime requisites in obtaining cheaper coal.

In the new Mt. Vernon Loader—for ease of handling—economy in operation—results obtained—to say nothing of price (which will be an agreeable surprise to you) we believe we have outdistanced all competition.

As light as good engineering will permit, and equipped with the auxiliary truck wheels, this loader has made many friends among those who have had to move other types.

Simple construction has made accessibility in upkeep outstanding —and think of it—no more greasing of bearings. All sprocket or roller shafts are ball bearing and require no more greasing by you.

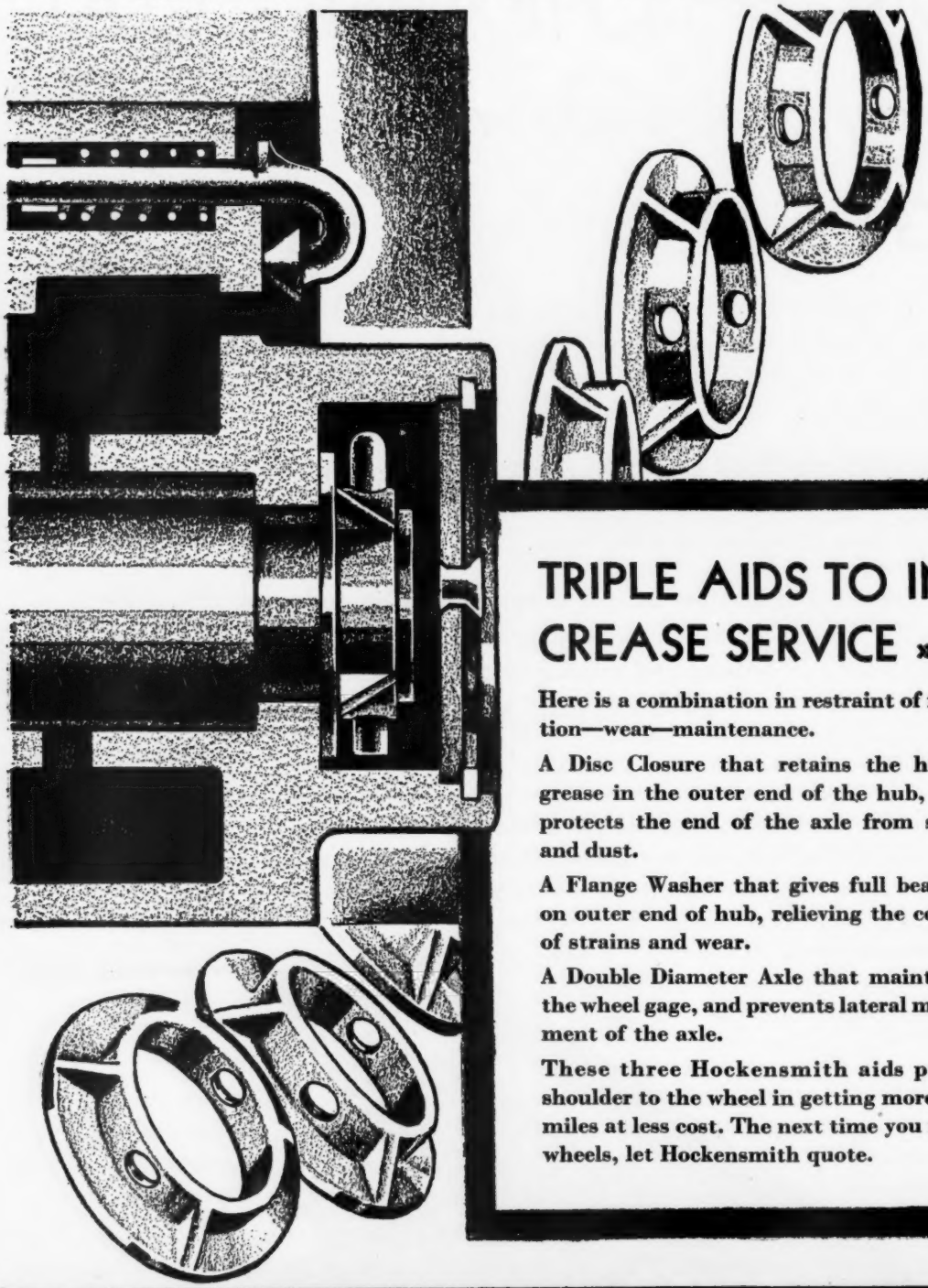
We will not say how much coal they will load—but four men will not cover it up.

DO YOU TOO WANT CHEAPER COAL?
Then write for our new specifications and our new lower prices.

Here is the new Mt. Vernon ready for operation. The pony truck which makes these loaders so easy to handle is folded up out of the way.

MT. VERNON CAR MFG. CO.
MT. VERNON, ILL.

« « « MORE TON MILES AT LESS COST » » »



TRIPLE AIDS TO INCREASE SERVICE » »

Here is a combination in restraint of friction—wear—maintenance.

A Disc Closure that retains the heavy grease in the outer end of the hub, and protects the end of the axle from sand and dust.

A Flange Washer that gives full bearing on outer end of hub, relieving the cotter of strains and wear.

A Double Diameter Axle that maintains the wheel gage, and prevents lateral movement of the axle.

These three Hockensmith aids put a shoulder to the wheel in getting more ton miles at less cost. The next time you need wheels, let Hockensmith quote.

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A light sinking drill of advanced engineering design with an exceptional performance record. Weighs only 50 lbs.

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Details That Make PERFECTION

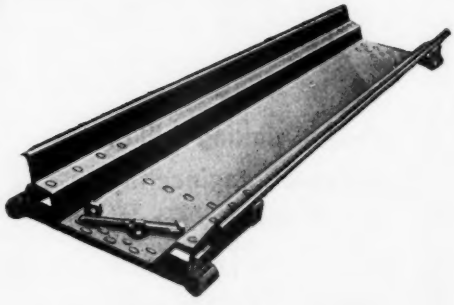
"Convey Your Coal the Cosco Way"

IT is the *basic principle* of the Cosco Conveyor System that insured success with more than 400 installations in American mines.

But it is the *perfected details* of construction that *keep Cosco on the job* day in and day out.

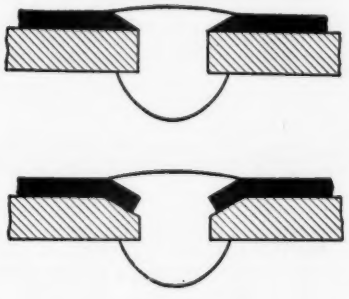
Cosco rollers, for example, are flanged by a patented process from steel plate and fixed to the axles in one operation. Shaped to fit the cradles at the start, there is less wear, smoother action and less consumption of power. And they are infinitely stronger than rollers made from any cast material.

So don't overlook the details when considering conveyor installations in your mines. Perfected details mean longer service, greater satisfaction and surer profits.



Steel Troughs That Resist Abrasion and Corrosion

Cosco Troughs are made of special analysis open hearth Manganese steel plate to withstand hard usage. Joints are accurately fitted and easily connected. There is great flexibility, with enduring strength throughout.



Reinforced Rivets

The upper illustration shows the usual way of riveting troughs. Note in the lower illustration how Cosco Troughs are riveted. Practically four times as much trough metal is held by the rivet head, making firm unions that will not easily loosen or tear out.

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COSCO

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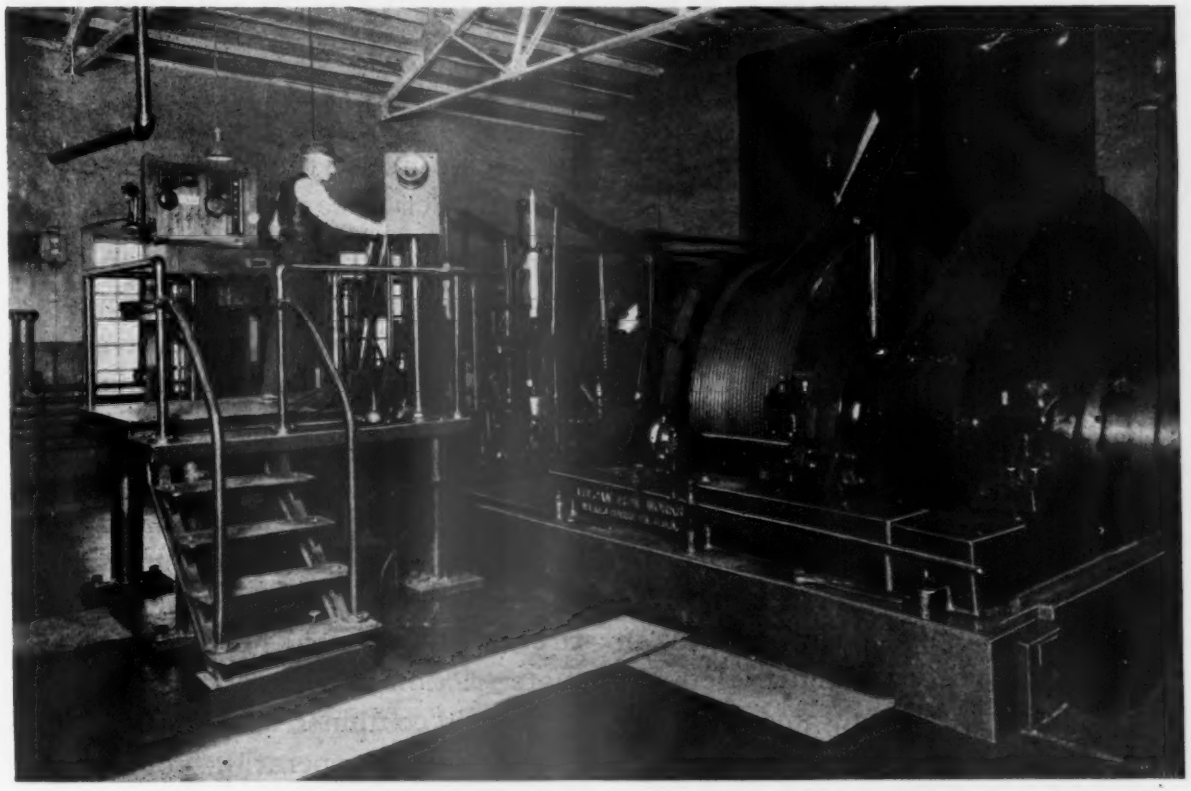
WITH the entire burden of a mine's output on its back, the safety of every man and the efficiency of every machine in the mine is subject to the dependability of the hoist. Here the reputation, experience and resources of the machinery manufacturer mean more, probably, than in any other piece of equipment. The knowledge that a long established and reliable manufacturer has built his reputation and dependability into your hoist is a decided satisfaction and has a real dollar and cents value to you.

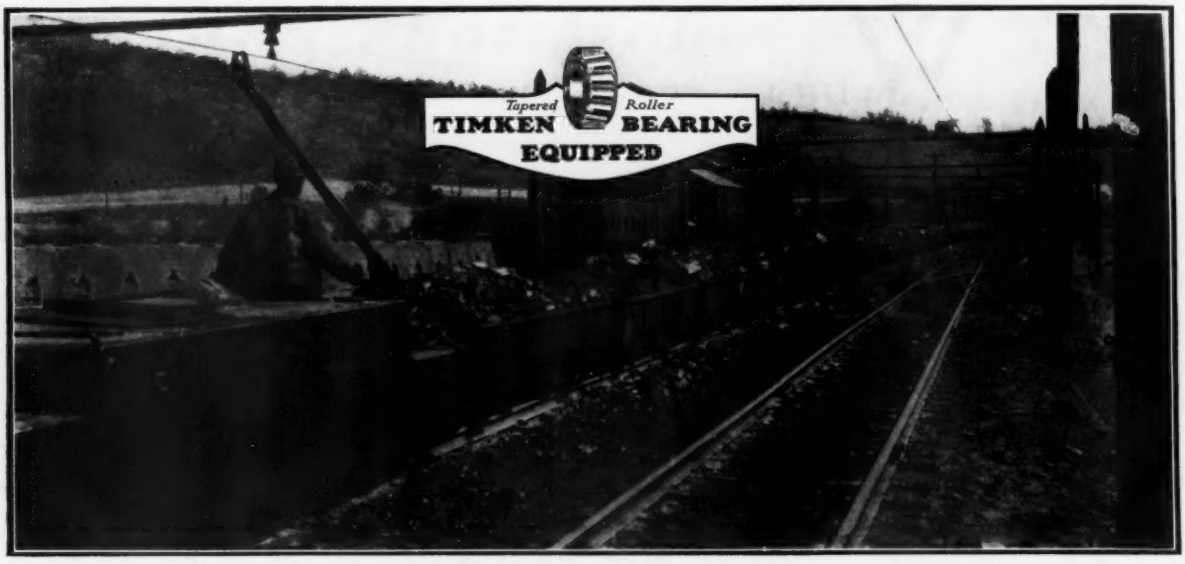
Vulcan's reputation has long underwritten safety and satisfactory performance in large and small mines throughout the mining world. There are Vulcan hoists that are still in active use after 60 years of service. Vulcan hoists embody the best in modern design and construction. As they are proven, new developments are adopted. Advanced engineering practice, high-grade materials and careful workmanship characterize them as they do the full line of Vulcan equipment.

The weight handled by this hoist is 2,900 lbs. for car, 6,700 lbs. for coal and 6,000 lbs. for cage. Total lift is 500 ft. and rope speed is 750 f.p.m. The hoist is operated by 600 H.P. motors, and has a 7 ft. drum with a 12 in. shaft.

Wherever coal and ore are mined Vulcan hoists, fans, locomotives and general mining equipment will be found giving superior service and satisfaction. Let us send catalogs of the equipment you need. Vulcan Iron Works, Wilkes-Barre, Pennsylvania.



VULCAN of WILKES-BARRE HOISTS



2,464 Timken Bearing Equipped Mine Cars *are* Now Operated *by the* Rochester *and* Pittsburgh Coal Company

Ever since The Rochester and Pittsburgh Coal Company, Indiana, Pa., discovered the greater efficiency and economy of Timken-equipped mine cars, they have been steadily adding to their number.

To date, the total has swelled to 2,464 Timken-equipped cars, in service at the following mines: Helvetia, McIntyre, Ernest, Yatesboro 1, 4 & 5.

Timken solved the anti-friction problem in mine cars—just as Timken Bearings have consistently led the way in every other notable anti-friction development throughout all industry for more than 30 years—and there are now more Timken-equipped mine cars in use than all other types of anti-friction cars put together.

In fact Timken-equipped cars are the accepted standard of the mining industry, and there is hardly a single mine of any consequence throughout the country that does not have some of them in service.

The reason is that Timken tapered construction is the *only* commercially practical principle that enables an entirely self-contained bearing to eliminate friction and to carry all thrust, radial and combined loads at the same time under all operating conditions. The Timken Roller Bearing Company, Canton, Ohio.

TIMKEN *Tapered Roller* **BEARINGS**

The
MINING CONGRESS JOURNAL

**A Monthly Magazine—The Spokesman For The Mining Industry—
Published By The American Mining Congress**

VOLUME 16 DECEMBER, 1930 No. 12

Editorials

Over-Production. PERHAPS no one subject has been more discussed by business men and economists during recent years than that of over-production.

An over-supply may be caused either by too great production or by too small consumption. The buying power of the Nation, if exercised to its fullest extent, might easily consume all of the present large production of supplies. Whenever consumption lessens, unless the producing agencies slacken at the same time, there is shortly an over-supplied market. The producing power of industry has been so largely increased by machinery and mass production that increasing consumption must be developed in order to stabilize business. Some authorities believe that our business depression has been brought about very largely by a slackening of the sales activities of our business organizations. Others believe that the enormous increase in credit sales through installment selling is responsible for this situation, and that the first requisite of a return to normal conditions is that our people shall get out of debt. Others believe that our governmental administration has drawn too much money through taxation in order that it might continue to boast that it has reduced the public debt at the rate of a billion dollars per year. Probably all of these and many other reasons can be logically presented as among the causes which have checked the upward trend of price levels. There is another school of economists who believe that a scarcity of gold as a basis of the currency systems of the world was and is responsible for present conditions. They point out that business depression began in the countries where a lack of gold support resulted in depreciated currencies, which in turn led to business confusion which, spreading from one country to another, finally overwhelmed the world. After giving proper consideration to all of these enumerated causes, we may come back to the fundamental condition that wherever the markets fail to consume in an orderly manner the supplies available for use there must either be a break in price levels or a reduction in the amount of supplies.

The Federal Farm Board has issued a circular entitled "Grow Less—Get More." It points out that the law creating that board directs it to "investigate conditions of over-production of agricultural commodities and advise as to the prevention of such over-production." This legislation was regarded as necessary not only by Congress but by that greater force which it represents—the American people. In considering this fundamental principle it is passing strange that Congress did not include in its recommendations some plan to prevent over-production in the wasting assets of the Nation—its minerals. It is generally believed that the coal industry is wasting approximately 40 percent of its reserves because those wasted reserves can not be produced at a price at which they can be sold. In other words, the industry is hogging its reserves, taking out only that part which can be produced cheaply enough that it may find a place in the market and wasting beyond all hope of future recovery minerals which will some day be needed to sustain our industrial life. In the petroleum industry the National Oil Conservation Board has expressed its ardent interest in means by which the development of oil fields not needed for present requirements may be controlled. Every line of public thought is averse to waste, but at the same time through the Sherman Anti-Trust Law deliberately and persistently refuses to permit such cooperative action among the producers of minerals as will enable them to conserve the Nation's resources, which, once exhausted, can never be replaced.

Grow Less and Get More is a good doctrine for the agricultural industry, but it is a crime for the minerals industry, and this notwithstanding the fact that agricultural supplies can always be reproduced, while minerals once exhausted are exhausted forever.

Is it not time that Congress, as the representative of the public interests, should give serious consideration to plans under which the wasting assets of the Nation may be so conserved as to protect the requirements of the future?

For the Aid of the Silver Industry THE bringing to fruition of some plan for the increased use of silver as subsidiary coinage in the monetary affairs of the various countries of the world is a subject of engrossing interest and a controlling factor in world business affairs.

The gold standard is fundamentally sound and likely to command the continuing approval of all highly developed industrial countries. Granting this, we also believe that the world's gold supply, properly distributed, is insufficient in volume to meet general requirements, even with the increased celerity of movement and the large expansions of credit which have increased the usefulness of gold. With the wealth of half the people of the world tied up in silver and with their apparent willingness to make silver the basis of their currencies, the movement toward forcing a gold standard upon those far east countries seems to point to additional burdens upon gold, already carrying a very heavy load. The price trend of silver during the recent past has in effect cut in half the wealth of more than three hundred million people and must in the end largely limit the purchasing power of those nations.

Whether it is feasible to stabilize the price of silver by international agreement, or whether an agreement among the silver producers of the Western Hemisphere to limit as far as possible the production of silver, or whether our efforts to aid some of these countries in stabilizing their governments, thus assisting in developing their purchasing power and aiding in maintenance of stable price levels, are questions of serious importance.

Who are the "Lame Ducks"

AGAIN after a major election we hear the cries of those who lament what they term the Lame Duck Session of Congress. Without entering into a discussion of the merit or demerit of the proposal long advanced that Congress should do away with the present method which permits a Congressman to hold office several months after he has been defeated for reelection, just what does it mean in the present Congress . . . just how many "lame ducks" will be on deck, and who are they?

We find in the Senate that Senator Ransdell, of Louisiana, and Senator Simmons, of North Carolina, earned that sobriquet. Out of a total of 96 Senators, only 7 failed to return. Both Senators Ransdell and Simmons had been in office for more than 30 years. The other 5, with the exception of Mr. Heflin, of Alabama, were new men in the Senate. With the "lame duck" contingent limited to but 7 members, there certainly is little to be feared as to their disturbing influence, or much to be hoped for had their successors immediately taken their seats. There are 435 members of the House. Of these, 61 failed to return, or a total of but 7½ percent. Of this number, 4 voluntarily resigned from the House to run for the Senate, for which office they were defeated.

In the short session, little other than Appropriation and Administration bills are considered. It seems to us that the country is still safe, even if our new friends are not permitted to take a hand in affairs until the coming long session of Congress.

The Price of Public Office

A MAN entering public life in the United States earns all of the dubious honors the office holds. He is at once the target for the enemy and the stronghold of those who support him. He is subject to political attack; he must meet the view of the majority of his constituents, must withstand the barrage of ridicule and condemnation of a satirical press. He must, alas, submit to the present low estimate of the public of its government officials.

To say that such a situation is unfair is trite. The Government of these United States is for the most part guided by able men; men who have been personal, financial and moral successes; men who, without too much thought of personal aggrandizement, are willing to contribute to the welfare of the masses out of their store of experience and ability.

The United States Congress is an open target. Many of its representatives are subjected to cruel criticism, because they do not fall in line with popular thought. The Congress is largely the same as it has been for many years. The same men have legislated for and against many proposals and, in the final analysis, their job must have been fairly well performed, because we are today the pride and envy of the world. There are some cynics who will point out that we have risen above our legislatures and achieved success in spite of them. Nevertheless, the five hundred and thirty-one men making up Congress have it in their power to defeat instead of develop constructive leadership.

This public criticism does not confine itself to the Congress. The President, the Cabinet, the Scientific organizations, the heads of Departments, Bureaus and Commissions, each must expect, and rise above, criticism, both wise and unwise.

In a recent book, Prof. Felix Frankfurter, of Harvard University, in the defense of the men who comprise our Government, says:

"No one can live in Washington without coming in contact with innumerable individual instances of fine ability and devotion leavening the lump of bureaucracy. * * * My observation of the public service * * * is that with all the defects of that service—and there are many of them and some scandals, just as there are in private business—the true story of its accomplishments would disclose an astonishing and magnificent net balance on the credit side."

Inexcusable Wastefulness

THE mining industry, along with other major industries, is seeking every possible means to reduce production costs. A means at its disposal is presented in the two articles in this issue presenting what has been accomplished along lines of standardizations of mining methods, practice and equipment. The results that have been obtained are most interesting. In presenting the accomplishments of the coal industry in standardizing, the author forcefully says:

> "The 'run-of-mine' day at a coal operation witnesses the use of hundreds of standards that are not thought of as such. Several important standards cover bolts, cement, concrete reinforcing, spiral steel rods, fire hose and fire hose couplings, machine tools, motor ratings, pipe flanges and fittings, pipe threads, rails, rivets, screw threads for bolts, machine screws, nuts and commercial tap holes, shafting, and wire. Seldom, if ever, are these recognized as representing the conscious efforts of some organization or group of organizations to standardize. These, as well as the mining standards enumerated above, represent a barrage of heavy artillery that can be effectively laid down to make the enemy position of high production cost untenable. These missiles of modern business warfare should be put to use intensively and intelligently. Many others should be created to follow up. Without many of the standards being used today, the condition of industry would be chaotic. Wasteful variety in design and construction of mining equipment is inexcusable and expensive. Wasteful and unsafe practices are still more expensive and even less excusable. The movement is naturally away from such waste, as a brief look in retrospect at mining conditions will quickly reveal. This movement is being accelerated by the activities of 300 men who are earnestly engaged in the activity of creating coal-mining standards."

This means of cost reduction is available to all. We urge the industry to investigate its possibilities, and to adopt such of the recommendations as can profitably be applied to their particular operation.

A Condition of Mind

RECENT nation-wide investigations indicate that the consumption of goods in the United States during the first ten months of 1930 was approximately 5 percent less than during the corresponding ten months of 1929. It is also suggested that the average price level reduction on these classes of goods was approximately 5 percent. This would indicate that the amount of goods sold by retail stores has been about the same during the first ten months of 1930 as during the same period in 1929.

During this period, merchants' stocks have been very largely decreased as well as the stocks in the hands of the manufacturers. A recent report of the J. C. Penny Stores Company is to the effect that the average inventory of each of their many stores was approximately $4,700 less on October 1, 1930, than that on October 1, 1929. The Penny Company is a growing and an aggressive organization. Its reduction in stocks is not likely to be less than the average of other merchants throughout the country. If this is true, it must follow that the amount of stocks now held by the retail merchants of the United States is many hundreds of millions less than when the foolish pyramiding of stock prices reached its zenith and toppled over on the business of the country one year ago. Merchants can not continue to sell goods for any lengthy period of time without replenishing their stocks. The reduced purchases by consumers of raw material has brought the prices of metal to the lowest point in many years, in many instances to below the actual cost of production. These prices can not continue much longer. Whenever purchasers believe that the bottom price level has been reached, there will be a rush of buying orders. Already there are signs that large consumers, fearful that an advance may come any moment, are placing large orders for materials. The Pacific Coast Electric Company recently placed an order for 12,000,000 pounds of copper with the Anaconda Copper Company; the Missouri Pacific Railway has recently placed an order for $2,000,000 worth of steel rails with the Colorado Fuel & Iron Company. These are but samples of many signs looking to an early return to normal business conditions. The United States has more money than it ever had before, more backs to clothe, more mouths to feed than ever before, and a stable government in the midst of a world of tottering nations. The United States will be the first country to again reach those normal conditions in which every man who desires work will find opportunity, and we shall again live in a more prosperous condition than any nation ever heretofore enjoyed.

Too Fat to Fight

MERLE THORPE, as the editor of *Nation's Business*, has performed an unusual public service in his discussions of the industrial and economic conditions of our country. He is rendering a still greater service through radio addresses in which he reaches so large an audience with the well-grounded hopes and aspirations of the American people. He doesn't hesitate to criticize improper conditions, but his criticism always furnishes the facts upon which his optimism is based.

In a recent radio address he used a phrase with reference to our present industrial conditions which is deserving of special consideration. After outlining the enormous wealth of this country, the fact that we have more money, more productive machinery, more basic supplies, and more labor than ever before, yet in the midst of this plenty we are suffering a business depression—"too fat to fight." This was the expression used, and as applied to the Nation as a whole the expression seems to precisely fit the situation.

Mr. Thorpe points out that what the Nation needs is not to restore the buying power, but to set that buying power into motion. Whenever the Nation as such shall realize the fundamental truth of this suggestion, business will take an immediate turn for the better.

The Machine and Unemployment

THE conflict between high wage levels, mechanical methods of production, unemployment, competitive prices for products, and a reasonable profit is unending and, during the present crisis of general business depression, is more acute than ever.

The efforts of organizations to find employment for all those wishing to work has brought forth some interesting facts and many sidelights on industry. All over the United States men are out of work. Raw materials generally have curtailed production. Copper, lead and zinc, iron, and coal, each has been forced to reduce its output to meet market demand. The decreasing of output has naturally brought on its share of released men and contributed to the discomfort of many workers.

Along with this situation, the indictment is heard again and again that mechanization is a major cause for unemployment. That the machine should temporarily be eliminated in order that more men may find work. Efficiency should be subordinated to expediency.

Perhaps the fairest presentation of the situation was made by the Illinois Coal Operators' Labor Association in a letter to the Unemployment and Relief Commission of the Governor of Illinois. After calling attention to the fact that, in spite of agreements between operators and miners' unions, 49 strikes in Illinois coal fields have been reported, which involved 21,000 men, who lost in wages a sum estimated at $1,622,000, and the further fact that these strikes were and are unnecessary, and that the industry has suffered severely because of these disturbances, adverse freight rates, and competition, they state:

"The adjustment made necessary by the installation of mechanical equipment has been designated as one of the contributing reasons for some of the distress in the coal fields; but this association places itself squarely upon record that production by mechanical methods is the only way by which the Illinois coal fields can meet competition from other fields, and the competition provided by substitute fuels, and maintain the present high wage scale; and with the restoration of harmony in the ranks of the mine workers, the operators will undertake as their share in the solution of the unemployment problem in Illinois to offer employment to many thousands of additional wage earners, and to continue such employment so long as the seasonal requirement and the demands of industry will permit."

The Illinois situation is duplicated in many industrial fields. Mechanization is frequently the means by which industry is kept running, and is not the primary cause for unemployment. Its elimination will not relieve the situation. Rather it will contribute to it, because those industries that can not economically compete must close. If we are to apply the theory to its logical conclusion, why not eliminate all machinery—go back to first principles and carry the coal up the shaft in baskets.

Selling Heat

UTILIZATION of coal, in its raw form, is becoming unpopular. The dirt, dust and general messy conditions attendant upon the receiving, storing and firing of coal are unpleasant and the consuming public feels increasingly that in this progressive age it is entitled to better treatment. In the ultimate, the thought and desire of the public governs the trend of what that public must eventually receive.

After all, why is coal mined? Because of a demand for heat, light, power and by-products essential to our present-day civilization. Our population, in enjoying the benefits that accrue through the use of coal, has no desire to be in contact with the raw article and to suffer the discomforts and unpleasantness of such contact. This feeling has been sensed by progressive distributing organizations in the coal business with the result that the sale of heat is now the new order of the day and the individual citizen will soon be receiving his heat as he now or soon will receive his light, refrigeration and household motive power.

It seems to us that herein lies opportunity. The very thing that is making more livable the lives of our citizens, that is permitting them to devote an increasing amount of their time and attention to still further progress stands essentially unbidden at the very door of every coal operating man in the United States.

Use electric power in every mining process throughout the mines. Reduce the cost of production of coal through this means. Furnish the best and lowest coal fuel in the world for power production in our country. Low-cost power will be immensely and universally popular with our people and to the last one they will become lavish users thereof.

And the result—no one will tolerate discomfort from cold, from heat, from darkness or from lack of power—a demand for coal will develop such a demand as has never been known.

The Increasing Need for Safe Production Methods

EACH time there is a major disaster in the mines, new impetus is given the Safety Movement and still greater effort is made to prevent a recurrence. There has been a steadily growing Safety-consciousness in the mining industry. Everything that has contributed to safe production has been investigated and, if found effective, is adopted by progressive companies.

With the growth of Safety-consciousness has come the development of Safety organizations. The Bureau of Mines, the chief Safety Organization in the mining industry; the Mining Section of the National Safety Council; the local and state safety organizations; the individual company safety organizations and campaigns; the collective force of the growing knowledge that accidents can be prevented—all have had their effect.

And yet, in the mining industry, we continue to have major disasters. Are we making any progress in eliminating accidents? John T. Ryan, of the Mine Safety Appliances Company, an authority upon the subject, recently gave some statistics which answer that question so far as the coal industry is concerned.

"Statistics indicate that all this organized safety work has not been in vain, as we find that in the 10-year period from 1906 to 1915 the fatalities per million tons of coal produced were 5.30, and during the next 10-year period of 1916 to 1925 the rate was 3.91, and for the year 1929 was 3.62. The reduction in 1929 over the first 10-year period was 32 percent; and surely the results have justified the effort when you consider the greater hazards now existing as compared to 20 years ago.

"The present and continued economic condition of the industry will undoubtedly be reflected in the safety record for the year 1930 as indicated by the record for the first seven-months' period, during which the death rate per million tons mined was 3.71 as compared with 3.44 for the same period last year. The actual number of deaths declined 3 percent, but the output declined 10 percent. It will be very fortunate if 1930 does not show a record surpassing that of 1929 in the list of fatalities."

Aside from the strictly humanitarian aspect, the cost of accidents to the mining industry is appalling. There is urgent need that Safety be given determined emphasis, that every company adopt every possible safeguard and take advantage of the organizations that are designed to assist them in this problem. Organized Safety is the only means by which accidents may be prevented. Safety involves the personal equation and, until each worker is imbued with the desire for personal safety, results will be unsatisfactory; and, until the economic situation shall permit each company to adopt adequate safety precautions, accidents will occur, but they can be reduced to the minimum if all of those in responsible positions make the attainment of a Safety Record their business.

Growing Government

THE many agencies in our Government that deal with mining might easily give rise to the suspicion that mining is in line for the application of the old axiom that "everybody's business is nobody's business."

The astounding fact is that there are sixty-three (count them) departments, bureaus, commissions, boards and committees located in the Nation's Capital charged with matters pertaining to the mines. What are some of them? The Hydraulic Mine Board, the War Minerals Divisions of the War Department, the Federal Trade Commission, the Tariff Commission, the Bureau of Mexican Affairs, the Census, the Simplified Practice Division of the Department of Commerce—to say nothing of Immigration, Conciliation and Blue Sky Commissions and our more familiarly known Bureau of Mines, Geological Survey, Bureau of Internal Revenue; and then there is Congress itself!

Many of these are extremely helpful. Most of them are perhaps necessary. Yet the total is slightly appalling to the industry they seek to assist, or regulate, or from which they secure information.

And now Senator Capper has started with renewed energy to press his bill for the creation of a Department of Education. The result is rather nation-wide publicity against further extension of the Government's arm in paternalism. The press has been quite vocal about it. Opinion seems to be crystallizing—and it isn't favorable to any more bureaus. But there is no limit to the ambition of the reformer. Steadily the Federal Government has absorbed the states' prerogatives in the matters of control, regulation, taxation and research in industry.

It is time to stem the rising tide of bureaucratic Washington, time to lop off some of the Government agencies, to consolidate others, and to simplify instead of muddle still further a complicated situation. Sixty-three agencies investigating, battening upon, serving and pestering the mine operator! Quite a sizable army with which to cope.

What
The AMERICAN MINING CONGRESS
means to the mining industry

By Louis S. Cates

President, Phelps Dodge Corporation, Director, The American Mining Congress.

NO INDUSTRY is so self-sufficient that it does not require the cooperation of other industries, and no industry may truly interpret itself without the aid of a "common denominator." That perhaps is the reason for the rapid advancement of the trade association and for the increase in cooperation between industries.

The mining industry is a gigantic affair. Each of its units constitutes a vast industry. Yet some of the problems in each unit are inherent in all. Stabilized production, taxation, simplification of methods of production; dissemination of accurate information . . . . are problems that apply to coal as well as to copper, to lead, and zinc as well as to iron ore.

It was this need for cohesive effort that led to the development of a national mining organization—The American Mining Congress—and it has been this need that has made this organization the great "common denominator" of the mining industry.

The past history and accomplishments of this organization are well understood by the majority of mining men. Its work in the development of mining, in the solution of practical operating problems, in the protection of mining markets, in the securing of favorable administration of mining laws, in the protection of the industry against unjust legislative proposals, its advocacy of legislation that will benefit the industry, all stand as a record of achievement and as indicative of what may be accomplished under sound leadership.

Such an organization is necessarily many-sided. It is consequently impossible for any one group to be fully cognizant of its full scope. Its activities for the coal industry constitute an entity, except where those activities dovetail and coordinate with the problems of copper, or lead and zinc, or iron, or gold and silver, or other minerals.

The work of the organization is divided into three major groups. Its Metal Section, as represented by the Western Division; its Coal Section, as represented by its affiliated organization, and the Mechanization Program sponsored by it; its Manufacturers' Section, as represented by its Manufacturers' Division. Its work is conducted through state chapters, operating in the important mining states; through the cooperation of national voluntary committees and through the direction and cooperation of a board of directors, highly representative of all branches of mining. Thus, at the national headquarters, special attention is given the question of equitable taxation of minerals. Equally, considerable data are collected and made available to Congress and others concerning the needs of mining in any reorganization of tariff schedules. Its national cooperating committees include a committee, representing each state, which is constantly working in an effort to arrive at sound and just taxation; another committee, of approximately 100 men, is constantly working for the advancement of mechanization in coal production; still another committee contributes to the interchange of data that makes possible cost reduction through simplification of mining methods, practice and equipment.

The work of the Southern Division, whose special duty is the development of the potential mineral resources of the South, is bringing to that section a stimulus that in future years means greater wealth for the country. Facts are coupled with industrial surveys, and the information so obtained disseminated to boards of trade, chambers of commerce, and clubs throughout the country.

What The American Mining Congress means to the mining industry can not be said in a few words. It is perhaps the greatest single factor in the future development and success of the industry. Its influence is far reaching. Its foundation is solid. Its platform, advanced, approved and adopted anew each year, is arrived at by the soundest of routes and is fully representative of the great industries for which it speaks with such authority.

In brief, this organization is a great cooperative organization, expressing the will of the industry, assisting in formulating its policies, interpreting the language of mining into creative and helpful service, and bringing about a national coordination of interests in a basic industry. It goes further and assists in coordinating that great industry with other great industries with similar and allied problems. Thus we find in its Stabilization Program the cooperative effort of such organizations as the American Petroleum Institute, the American Zinc Institute, the National Coal Association, the Anthracite Institute, the Copper and Brass Research Association, the Lake Superior Iron Ore Association, and the Lead Industries Association.

As the "common denominator" for the mining industry, The American Mining Congress has stood the test of time. It is now in the thirty-third year of its service, and each year has seen it more solidly entrenched, rendering greater and greater service and bringing together in closely knit unison many of the factions that might otherwise be waging war against, instead of for, each other.

The American Mining Congress stands at once the great wall between the mining industry and unfair proposals against it, and the open door to a cooperative effort that offers limitless opportunity. A "common denominator" that reduces each problem to its simplest equation and through its wide resources achieves where a lesser organization would fail.

By

Robert E. Tally

Stabilized Mineral

Robert E. Tally

PRESIDENT OF THE AMERICAN MINING CONGRESS AND
PRESIDENT OF THE UNITED VERDE COPPER COMPANY

THE mining industry, particularly that of the major base metals, and of silver and coal, is in the throes of one of the most serious depressions of modern times. Its condition is more serious than that of most other industries, and unless the situation is relieved wage reductions, further unemployment and shutdowns will result.

The acuteness of the situation is due primarily to the prevailing world-wide business depression, with its consequent underconsumption and the inability to adjust supply to demand.

The industry, however, is over-developed even for normal times, and its future requires a reasonable and well-balanced stabilization plan, one that will adjust supply to demand and maintain normal inventories.

Stabilization, particularly of copper and some of the other base metals, should be, and theoretically is, a relatively simple matter, but in practice it has proven most difficult of accomplishment. The difficulties are the Sherman Anti-trust laws, which forbid collective curtailment, the only effective means for the adjustment of supply to demand, and the unwillingness of an appreciable number of producers to individually curtail.

Producers have the right to adjust their own production as they see fit, and, while a majority of them have made an attempt at curtailment, it has not been sufficiently general to be effective.

It is a well-recognized fact that the producer operating on a curtailed basis is at a considerable disadvantage unless his competitors follow suit, and to an extent that the adjustment is effective.

Failure to bring about such an adjustment creates chaos in an industry. Mines are depleted with insufficient returns to the shareholders, making the industry unattractive to conservative investors; wages are unstable; employment uncertain and entire communities are seriously affected.

The great needs of the mining industry are honest cooperation among producers and a revision of the Anti-trust laws to an extent that collective curtailment is permissible and encouraged, at least when metal stocks are above normal. Anti-trust laws are needed for the correction of unfair competition and other abuses, but they should not operate to the detriment or destruction of industry.

Cooperation between producers in the adjustment of supply to demand is of equal if not of more importance than a satisfactory revision of the Anti-trust laws, for revision without cooperation will be of no material aid. Cooperation is essential to and should follow the legalizing of collective curtailment.

Stabilization should not attempt the maintenance of fixed prices, but should aim toward reasonable maximum and minimum limits, depending on general business conditions and competition from other metals and commodities.

There are many other factors of more or less importance in connection with stabilization, but these have been discussed in previous and more detailed papers on this subject, and will not be repeated at this time.

Cooperation among producers, and revision of the Anti-trust laws, are the two great needs of the mining industry, and if the United States Government will do its part and cooperate with business to the extent of a reasonable revision of these laws the mining industry and business in general will show an immediate and favorable response.

Production

Switchback tracks at United Verde operations, Jerome, Arizona.

Some of
GOVERNMENT'S CONTRIBUTION
to mining

By Scott Turner

DIRECTOR OF THE
UNITED STATES BUREAU
OF MINES

THE United States Bureau of Mines was created, and is operated, to help the mining industries. The special field of this bureau is fact-finding, and then making the facts available to all. The words investigation, education, and cooperation are descriptive of our activities.

The bureau wishes to orient itself to the public and the mining industry; it must ask and answer questions; learn and teach; help and be helped, all in the interest of the common good. For instance, when its engineers inspect mines, mills, and smelters for the purpose of assembling and later disseminating information which the industry has acquired through long experience; or when it conducts special studies in field and laboratory; and when it is instrumental in saving lives, or in bringing to general attention cheaper and better ways of producing minerals, the bureau is acting within its proper sphere.

The part the United States Bureau of Mines essays to take in mining is to ascertain those practices and methods by the use of which the mining industry may be made a safer field for the millions of workers who earn their livelihood therein, and to disseminate this information through a vigorous campaign of education; also to help in every way possible in devising less expensive, less wasteful, more profitable and more efficient methods of mining, treating, marketing, and utilizing the numerous essential minerals with which our country has been so bountifully provided.

The mine-safety activities of the bureau are perhaps those deserving first consideration. With some 2,600 fatal accidents and approximately 200,000 lost-time injuries occurring yearly in the mining industry, it is imperative that everything humanly possible be done to make mining a less hazardous occupation. Even if one forgets for a moment the humanitarian aspect of the matter, there is the inescapable fact that accidents and disasters mean monetary losses; safe practices may often prove the cheapest in the long run.

Coal-dust explosion issuing from main portal of Bureau of Mines Experimental Mine. The white patches in the clouds of smoke are flames

A class of officials in the Bureau's advanced first aid and mine rescue course, in the Lake Superior District

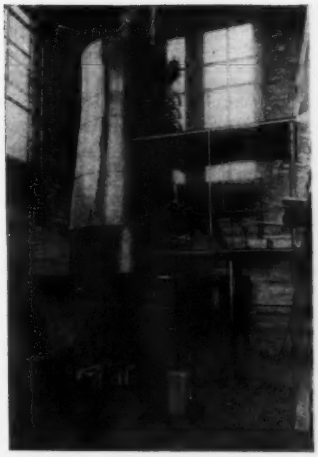
The bureau operates 11 mine-rescue railway cars, each having the latest approved devices and equipment, primarily for instruction purposes, but also for use in case of mine disasters. The bureau also maintains 11 instruction and mine-rescue stations in as many mining regions; at each station is an automobile truck fully equipped with mine-rescue apparatus. Whenever news of a mine disaster is received, the bureau's experienced safety workers are immediately placed at the disposal of the authorities, state or company, to give as far as possible such assistance as may be desired.

The field men of the bureau's safety division are continually engaged in the instruction of miners in methods of giving first aid to the injured and in the use of mine-rescue apparatus. During the last fiscal year, 112,570 full courses were given in mine rescue and first aid to those employed in the mining and allied industries in 765 towns and 38 states and Alaska. This was the largest number of men trained by the bureau in a year's time. Since the bureau's establishment more than 400,000 persons have been given these courses. This means that in practically every mining community there are men trained in first-aid and mine-rescue methods, who are immediately available in time of disaster. There is abundant evidence that many lives have been saved as a result of this work.

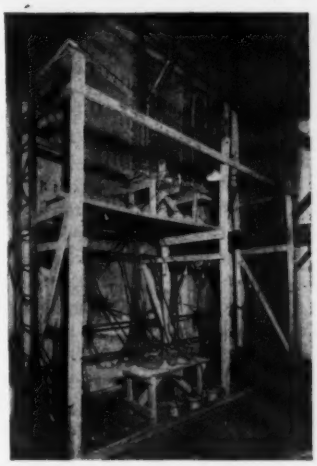
The safety division also directs its energies largely to obtaining and disseminating data on safety in mining. Among the numerous subjects studied are the causes and methods of prevention of mine explosions, the explosibility of dust and gases; proper care and use of explosives; recommended blasting practices; the bureau investigates the problems of haulage, electrification, ventilation, dusts and high temperatures; it studies timbering, lighting, the use of machinery, and, in fact, practically everything that may have a bearing on accidents in or around mines.

When the Bureau of Mines was established in 1910, the idea was not generally accepted that accumulations of dry, fine coal dust were highly explosive, and therefore constituted a serious hazard in mines. In the bureau's experimental coal mine at Bruceton, Pa., more than 1,000 coal-dust explosions have been brought about, and the fact of the explosibility of coal dust has been so thoroughly demonstrated that no informed person any longer questions the matter. As the result of this extensive series of tests, the relative explosibility of coal dusts from different seams and fields has been determined, and this information has been made available to the operators. The bureau has gone further and demonstrated conclusively that the explosions which have cost so many lives in bituminous coal mines may be largely limited or prevented by thoroughly rock-dusting the mines. Lists of sources of suitable material for making rock dusts, situated conveniently near the various mining districts, have been published for the benefit of the mine operators.

The electrification of the coal mines has contributed greatly to the ability of the American coal miner to produce a much larger per capita tonnage than is turned out by his European competitor. Electrification and mechanization have, however, introduced new safety problems. The bureau is constantly engaged in testing electrical mine equipment, and thus stimulating the production and use of machines and devices so designed as to avoid causing sparks and flashes capable of igniting accumulations of mine gases and thus initiating a mine explosion. It is now possible for the coal-mine operator to obtain equipment approved for almost every kind of underground mechanical operation. Much study has been put on safer types of miners' lamps.



Experimental iron blast furnace, the only successful one of its kind



Sampling furnace gases from a powdered coal furnace

Preventing oil and gas waste and recovering a greater percentage from underground is an important study of the Bureau

Permissible explosives, tested by the bureau, are safer than other types of explosives for use in certain conditions; use is increasing rapidly year after year. Lists of approved mechanical equipment and of permissible explosives are made available to the industry at frequent intervals.

Although public attention is attracted mainly by the major mine disasters in which the lives of scores of men may be lost, the greatest single cause of loss of life in the mines is falls of roof and coal. Approximately half of the annual toll of deaths in the mines results from this cause. The bureau is conducting a special study of this problem, and in districts where active cooperation has been obtained from the state mine inspectors and the mining industry, substantial results have been achieved in the reduction of these accidents.

The bureau's health division investigates hazards affecting the health of workers in the mineral industries, with the object of determining causes and devising methods of prevention. The effects of changes in the physical condition and chemical constit-

uents of the air; the matters of sanitary surroundings, toxic gases and vapors, gas masks, acid coal-mine drainage, causes of death among miners, medical organization, industrial hygiene, and incidence of silicosis and other diseases among miners are studied and recommendations made for prevention.

In the field of metal mining, the Bureau of Mines is striving to help industry to carry on in the face of low metal prices. The bureau, of course, can not undertake to solve the mining or metallurgical problems of individual operators, but must concentrate its efforts on matters of importance to the industry as a whole, or at least to the operators of a whole district or region.

The bureau's metallurgical investigations are conducted mainly at its experiment stations, situated in many Western States. The Rare and Precious Metals Experiment Station at Reno, Nev., carries on research on the efficient production of rare and precious metals, including the utilization of low-grade ores not now commercially of value. This station has made a special endeavor to assist in the development of deposits of various minerals of which the United States does not produce adequate commercial supplies. Special attention has been given to troublesome problems in the metallurgy of gold and silver. A study of smelting in the lead blast furnace is yielding information that should be of value to operators.

The Southwest Experiment Station at Tucson, Ariz., is concerned with the mining and metallurgical problems of the Southwest, especially those affecting the mining and treatment of low-grade copper ores. Special attention has been given to leaching problems, and a number of reports dealing with this subject have recently been published.

The Pacific Experiment Station at Berkeley, Calif., conducts research concerned chiefly with the determination of metallurgical constants. Data on specific heats of metals, oxides and sulphides, high and low temperatures, heats of formation, entropies, free energies, and vapor pressures, are only to be found scattered here and there through the technical literature of metallurgy. This station is presenting data on these subjects in a form useful to the metallurgist, thus supplying important gaps in the field of information; it is also redetermining those properties now believed to be incorrectly reported. This constitutes work of importance in the scientific solution of metallurgical problems.

The Mississippi Valley Experiment Station at Rolla, Mo., seeks to prevent waste and to increase efficiency in the important lead and zinc industries of the Mississippi Valley. It likewise serves as a center for the bureau's ore-dressing studies. This station has been able to give operators practical assistance in the reduction of milling losses.

The North Central Experiment Station at Minneapolis, Minn., works on problems connected with the beneficiation and smelting of maganiferous iron ores of the Lake Superior region, and with the study of fundamental blast-furnace reactions. With the aid of one of the few successful experimental iron blast furnaces ever constructed, data are being obtained as to just what takes place in the different parts of the furnace under varying conditions. This information has a bearing on greater efficiency in the design and operation of blast furnaces.

Studies in the physical chemistry of steel are being conducted at the bureau's Pittsburgh, Pa., Experiment Station. These studies are affording information of practical value in the problem of producing high-quality steel at low cost. The problems of the important Alabama iron-mining district are given particular attention by the Southern Experiment Station at Tuscaloosa, Ala.

The bureau's mining division studies improvements in mining and milling methods, with the object of reducing losses and wastes in mining and preventing accidents. Investigations of the division include such subjects as drilling and blasting, loading of ore and coal, mine timbering, the breaking and handling of ore and coal, mine ventilation, underground transportation, mine sampling methods, efficiency of mine labor, and mining and milling costs. The division has prepared an extensive series of reports giving detailed data regarding mining and milling methods and costs at representative mines of the country; these reports are being prepared by the bureau's consulting engineers, who are the managers and engineers in charge of these mining and milling operations. It is believed that this assembling and classifying of mining and milling data will aid operators in overcoming their technologic and economic difficulties, and should eventually increase metal recovery and reduce production costs. Special attention is being given to the subject of geophysical prospecting and field investigations are being conducted in various parts of the country.

The Nonmetallic Minerals Experiment Station at New Brunswick, N. J., conducts inquiries into the mining, treatment and use of the numerous important nonmetallic minerals. At present, efforts are being concentrated on the development of methods for the utilization of polyhalite, greensand, leucite, alunite, etc., as sources of potash. Extensive beds of polyhalite have been revealed by drilling done by the bureau in Texas and New Mexico, and there is promise that methods may be devised whereby these potash-bearing salts may be made useful as fertilizer.

The bureau has demonstrated the practicability of utilizing American kaolins, fuller's earths, and ochers, materials largely imported in the past. It has assisted the rock phosphate and the fluorspar operators in reducing losses. Introduction of the wire saw into the slate-quarrying industry has reduced wastes. Special studies of the mica, talc, cement, gypsum, and othe nonmetallic industries have given beneficial results.

The bureau station at Salt Lake City, Utah, studies the treatment of complex low-grade ores. The station gives attention to the study of flotation processes. The microscopic study of ores conducted at this station has afforded information which has been of benefit to many operators.

The bureau has recently published a large number of information circulars containing general data regarding the different nonmetallic minerals. These papers deal with barite, clay, diatomaceous earth, feldspar, graphite, gypsum, mica, mineral pigments, phosphate rock, silica, sulphur, etc. The bureau will forward copies of any of these circulars to persons interested.

The petroleum division of the Bureau of Mines was established in 1914. There was urgent need for broad and fundamental studies pertaining to petroleum and allied substances. Since that time the petroleum industry has grown rapidly, and with its development increasing numbers of trained specialists have been employed by the oil and gas companies. The problems of the industry have become more complex. Today engineers are confronted with questions regarding the economic as well as the physical limits of drilling to deep-lying formations, the effect of production-control on ultimate recovery, the many phases of unit operation, the widespread production, distribution and use of natural gas, and the manufacture of motor fuels and lubricants by processes which in 1915 had not been conceived. The field of activity and types of study of bureau engineers have changed. As before, our policy is to engage in the study of problems which have broad if not national or even international significance.

The petroleum and natural gas division is functionally organized to perform technical research on all problems relating to drilling, development, production, and transportation of petroleum and natural gas; also to the manufacture, refining, and utilization of products obtained from these natural resources and allied substances. Problems are selected for study only after careful con-

sideration of the general usefulness to industry, and to the public, of the findings which may be obtained.

One way in which the bureau has been able to be of service to the petroleum and natural-gas industries has been by conducting engineering studies of important pools in which the encroachment of underground waters, or other serious problems, have confronted the operators. The results of studies of more than 30 oil-pools have been published, and have shown how substantial increases in production could be attained.

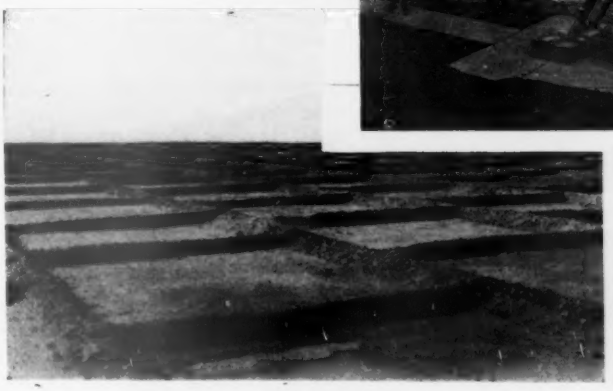
The bureau has given much attention to the problem of increasing the percentage of oil recovered from underground deposits. This is a matter of importance, as under present average practice no more than 15 to 20 percent of the oil is brought to the surface. Investigations of air-gas-life methods for flowing oil wells, the solubility of natural gas in crude oil, the flow of oil and gas through sands, repressuring methods, underground gas storage, etc., have been conducted; valuable data have been obtained and placed at the disposal of the industry.

Studies of evaporation losses of petroleum and gasoline have yielded much valuable information. Investigations of the flow of natural gas through pipe lines have been in progress for several years. The design and construction of pipe lines, development of new flow-formulas, and the measurement of natural gas by orifice meters are under study. Methods for the prevention of losses of natural gas in transit through pipe lines have been demonstrated.

Studies are in progress looking toward increased efficiency in the refining of crude petroleum, whereby more and better commercial products may be obtained. The treatment of light petroleum distillates, sulphur compounds in crude oil, and the separation of wax from wax distillates, are among the several problems now being given attention.

In addition to furthering the cause of safety in coal mining, the bureau has conducted many investigations designed to help solve the industry's economic problems. The bureau was a pioneer in the study of the fundamentals of fuel combustion and the transmission of heat. Before its establishment very little definite information was available regarding the characteristics of the coals produced in the United States. Large numbers of coals, from every producing district, have been tested to determine their steaming, gas-producing, coking, and briquetting qualities; many thousands of coal samples have been analyzed. This information, made available in numerous publications, is of the utmost value to the coal operator in the marketing of his product and to the large consumer in determining the coals best adapted for his particular needs.

The bureau studies the newer developments in fuel technology, such as the combustion of powdered coal and low-temperature carbonization. Attention has been given to use of new materials and new methods in the manufacture of illuminating gas,



Above, left: The Bureau helping reduce accidents from falls of roof. Above, right: Pendulum friction device for testing sensitiveness of explosives. Below: Much study has been given to leaching problems

and to obtaining more and better by-products in the coking of coal. The United States is the greatest coal-producing and consuming nation, and the bureau has endeavored to point the way to the more efficient utilization of the Nation's extensive supplies of raw fuel.

Investigations have been conducted with the purpose of assisting the coal-mine operator where special circumstances have made difficult the mining or preparation of his product. These investigations include the mining of thin-vein anthracite, and of the steeply-pitching coal beds in certain Oklahoma districts, and the better preparation by special washing methods of the coals of Alabama, Washington, and other states. A study of special interest now under way is the determination of the gas and coke-making properties of American coals.

The bureau has issued a large number of reports, instructing the fireman how to handle the various kinds of coal. Surveys of numerous Government boiler plants have resulted in the savings of hundreds of thousands of dollars annually to the Federal Government.

In any industry it is essential that accurate statistical data regarding its own activities be made promptly and easily available. The provision of such information is one of the duties of the bureau's economic branch.

The Coal Division conducts studies, as the result of which the bureau furnishes to the Government, the coal industry, and the public information on economic conditions and problems of the coal industry of the United States. This work relates to the industrial and commercial economics of coal as distinguished from technical problems. The field includes the uses of coal, reserves, prices, production, distribution, consumption, stocks, and marketing, and involves the collection, analysis, and dissemination of statistical data relating to the coal and coke industries.

The Petroleum Economics Division make statistical and economic studies relating to the petroleum, natural gas, and allied industries. The current economic data published are used widely by the industry. The work of the division falls under five major headings: Utilization of petroleum products; distribution of petroleum products; statistical reports, assembling of economic data; and foreign studies.

The Division of Mineral Statistics, functioning through its offices in several Western States, collects statistics of mineral commodities of commercial importance. It assembles information on the mineral resources and mineral products of foreign countries. It prepares monthly reports of production, shipments and stocks of Portland cement. Preliminary press statements covering the production of the different minerals are issued at the earliest possible date in the year following, and more detailed reports, forming the chapters of "Mineral Resources of the United States," are issued later.

Through its Rare-Metals and Non-Metals Division the bureau makes economic studies and disseminates information on a wide variety of mineral industries. In many cases the bureau has succeeded in (*Continued on page* 901)

The ANTHRACITE INDUSTRY Today

By Noah H. Swayne

THE anthracite industry of today has new problems. This expression is not intended to include the problems due to the general depression which are common to many industries. In one sense of the word those problems are new each time depression appears, but as depression passes away they will pass with it. Anthracite has a problem with which it has been unfamiliar until within the recent past.

For approximately a quarter of a century prior to the World War demand for and the production of anthracite were in relative balance, and the securing of equitable distribution was the principal question involved from the selling standpoint. The war period brought about a great change. Shipments of Pennsylvania anthracite to a large part of its consuming territory were, by Government order, materially reduced during the war in order that provision could be made for the needs of munition plants and the Government itself.

Locust Summit Central Breaker, Philadelphia and Reading Coal and Iron Co.

The effect of this condition was of no immediate consequence because the great increase of consumption of coal attendant upon the war activities in the territory adjacent to the Pennsylvania anthracite fields readily absorbed the tonnage, which, under normal circumstances, would have been shipped into the restricted areas, and in addition a considerably increased production, as the anthracite region responded to the patriotic impulse to expand its activities to meet the war demand. The conclusion of the war and the restoration of the right to ship without reserve into the restricted areas did not restore the industry to its previous position.

The great increase in transportation costs had resulted in considerably increased freight rates, with the consequence that the spread between the prices of Pennsylvania anthracite and competitive fuels raised a barrier which prevented a recovery of a large part of the more distant markets, notably the Northwestern States and Canada. The consuming public in these territories, and to some extent in New England as well, had been compelled by the war necessities to put up with less satisfactory fuel, and the price barrier was sufficient to prevent many of them from returning to anthracite. During the same time conditions similar in character, although not in extent, had brought about an increased use of competitive fuels in near-by territories.

The difficulties of operation under war conditions had somewhat affected the quality of the preparation, due chiefly to the depletion of the companies' inspection service. Anthracite found itself with a relatively excessive productive capacity, a somewhat damaged reputation for quality, a somewhat narrower market, and active competitors. The effect of this new condition was not felt immediately, because interruptions of

production resulting from strikes of labor on railroads and at the mines reduced output just about enough to keep it equal to the demand. These interruptions of supply, although they brought temporary relief, were in their long-time effect injurious in that they created in the public mind a feeling of uncertainty as to the future.

Five years ago a contract with the miners was made which assured uninterrupted production for five years, and that contract has been succeeded by another which gives assurance of six more winters of continued operation. It was therefore not until somewhat after the settlement of the strike of 1925-26 that the full effect of the war-time excitement was felt.

A sales problem confronted the anthracite industry for the first time in the fall of 1926. The industry found in this new situation no cause for dismay, but rather a new stimulus to progress. With its labor supply assured for years to come, attention was turned first to the matter of preparation, to restore quality to previous standards, and then to equip itself for the attainment of better quality than had ever been attained before. The restoration of prewar quality was largely a matter of management and operation of existing plants. A better quality demanded new and more modern plants and large capital expenditures. Capital expenditures are founded not upon despondency but upon faith.

The producers of Pennsylvania anthracite have demonstrated their faith in their coal by very large expenditures within the last few years in extensive construction and other development work. New concrete, steel and glass, steam-heated structures of giant size have in recent years displaced the unsightly and unheated wooden breakers of the past. A dozen or more such breakers have been built within the last few years at a cost, in one instance, of over $4,500,000 for one breaker. One company is spending $3,000,000 on a tunnel to drain its collieries. Concentration and consolidation of coal-preparation plants, electrification of mechanical equipment and transportation, are incidental to these construction programs. The purpose of these expenditures is to improve the quality of the product and maintain quality at a lower cost, that a better fuel may be delivered to the public without raising the price. The result of this large expenditure is now apparent. Coal produced today is cleaner, freer of impurities, more uniformly sized, than it has ever been before. Every possibility for improvement is being studied intensively and whatever expenditures seem to be justified by this study will be made.

Another step in the line of progress is the opening of the Anthracite Institute Laboratory at Primos, Pa., one of the suburbs of Philadelphia. In this laboratory, of which Allen J. Johnson is director, practical studies are being made of methods of combustion and heat regulation, as well as exhaustive tests of the efficiency of existing heaters and stokers and a number of various appliances that have not yet appeared on the market.

A third effort in the direction of progress is manifest in the appointment of Prof. Homer G. Turner, of Lehigh University, Bethlehem, as director of anthracite research. Most of the work will be carried on at Lehigh University under the direction of Professor Turner. As a branch of this program research fellowships have been established at Pennsylvania State College and Yale University.

This program will involve a detailed study of the physical and chemical properties of all coal beds of the Pennsylvania anthracite region. The X-ray, microscope, spectroscope, and other delicate instruments of modern science will be employed in revealing the secrets of structure and composition of anthracite. The knowledge thus gained will help to perfect anthracite as a solid fuel and may also lead to development of new uses.

The geologic aspects of anthracite and its associated rocks will be studied for the purpose of improving mining and revealing hidden beds of coal. It is hoped that this geological study will also lead to the discovery of many uses for the great banks of waste material which are so evident in the coal regions.

The research work at Pennsylvania State College will be conducted by Prof. Joseph B. Shaw, head of the department of ceramics in the School of Mineral Industries. This inquiry is prompted by the fact that a great deal of fire clay is taken out in mining certain deposits of coal and availability of this clay and other material in the region justifies exhaustive study of means to turn them to acount.

Anthracite is not a decadent or despondent industry. It has not stood still, but has solved its problems as it met them. For many years smaller sizes were thrown away. They are now recovered, cleaned, sized and marketed with as much care as is bestowed upon the larger sizes. The research workers are engaged in seeking not only ways in which to improve the handling and burning of the larger sizes and new uses for the smaller sizes, but also entirely new fields of usefulness.

The industry is today alert, aware of its problems, active in seeking the solution of them, and confident of the future.

The Marvine Breaker of the Hudson Coal Co.

WHAT'S AHEAD in coal production

By John B. Dilworth*

AT THE outset, permit me to say that I am not a confirmed optimist. I do feel, however, that in a period of general business depression like the present, following seven years of hard times in his particular industry, the bituminous coal operator is very apt to reach the unwarranted conclusion that there is only darkness ahead for him and fail to note the numerous signs indicating that the night is far spent and a new day near at hand.

In calling attention to some of these signs, I shall confine my discussion to certain conditions which lie, for the most part, outside of the coal mining and marketing industry itself, but which have had far-reaching effects on it. The situation within the industry—comprising mining methods, costs, preparation, prices, markets, etc.—is known far better to you gentlemen than to me, and I will not attempt to discuss its elements before you.

Everyone knows that the immediate cause of the present depression in the coal industry is over-development of mining—too many mines and too many miners. Several of the outside conditions which have contributed to this situation are so generally recognized that they need only be mentioned here. They are well worth noting, however, first, because of the important part they once played in bringing about present conditions within the industry; and, second, because we may rejoice in the fact that they have now ceased to exist and are unlikely to recur in the near future. These factors were:

(a) Shortages of railroad cars in times of strong market demand for coal.

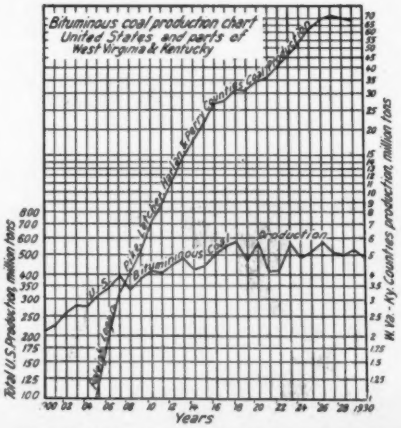
(b) Periodic strikes of large bodies of union miners.

(c) Abnormal stimulus to industry of the World War.

(d) Rapid development of virgin coal fields in southern West Virginia and eastern Kentucky between 1906 and 1926.

A word of comment on this last factor seems in order lest its importance be underestimated. In the comparatively recent past, vast areas of thick, outcropping coal beds in the isolated mountain sections of West Virginia and Kentucky were brought at low prices by large mining interests. Favored by natural conditions, low-priced unorganized labor, good transportation facilities and excellent coal quality, the purchasers, or their successors, rapidly opened a great number of mines and an enormous tonnage of this coal entered the markets of the country, displacing much coal which would have been supplied by already existing mines in older districts, and thus contributing to the overdevelopment of the industry.

The rapidity and magnitude of this invasion of southern coal is indicated on the accompanying graph marked "Bituminous Coal Production Chart." These are logarithmic graphs comparing the rate of growth of coal production in six important West Virginia-Kentucky counties with that of the United States as a whole. They show that while the country's average bituminous output increased only 70 percent in the 12 years from 1906 to 1918, and has declined slightly since then the output of these southern counties doubled every 4 years, as an average, from 1906 to 1926, and amounted in the latter year to 70 million tons. This growth has recently been arrested.


Bituminous coal production chart
United States and parts of
West Virginia & Kentucky
Total U.S. Production, million tons
W.Va.-Ky. Counties production, million tons
Years

BITUMINOUS COAL PRODUCTION CHART

There is no prospect of a duplication of this situation in the future, for there are no more such virgin fields to be developed in this country and the cream is being rapidly skimmed from those just mentioned, leaving fewer and fewer areas of cheaply mined, high grade coal to invite exploitation by new mines.

UNQUESTIONABLY the most potent of all outside causes which have brought about the present overdevelopment and consequent distress of the bituminous coal industry has been the stoppage of growth of the country's consumption of coal during the last decade.

For almost a century prior to 1920 the bituminous coal consumption of the United States, together with the export business, practically doubled every decade. Since 1920 it has fluctuated around 500 million tons a year instead of increasing at the century-old rate to approximately a billion tons per annum at present.

Two main causes have operated to bring about this situation, namely,

(a) Greater efficiency in the use of coal.

(b) Inroads of substitutes for coal.

Undoubtedly in the past decade a marked increase in the efficiency of coal-consuming equipment and appliances has been a major factor in retarding the normal increase in coal consumption. Due to this cause alone, 500 million tons of coal are now doing work which would have required at least 650 million tons 10 years ago.

To cite two illustrations: a recent study by Messrs. F. G. Tryon and H. O. Rogers, of the United States Bureau of Mines, shows that public utility steam-electric plants burned, to produce a kilowatt-hour of electrical energy, 3 lbs. of coal in 1920, but only 1 2/3 lbs. in 1929, a reduction of almost one-half in 10 years. An average railroad locomotive consumed, per 1,000 gross ton-miles freight service, 174 lbs. of coal in 1920, but only 127 lbs. in 1928. Similar fuel economies were secured in many factories, and in the iron and steel industries. In all, about 70 percent of the coal consumption of the country has been so affected.

Such economies in railroad consump-

* E. V. d'Invilliers Engineering Company. Presented to October 16 session of the Thirteenth Annual Meeting of the National Coal Association, Detroit, Mich.

tion were brought about mainly through improvements in locomotive boiler and engine design and by better operating practice. This has been an important element in reducing coal consumption, for railroads use 28 percent of the nation's coal output.

Public utilities have reduced fuel consumption not only by improved equipment at their individual plants and by substituting a comparatively few large central steam-electric stations for many small ones, but also by inducing many private industries to abandon their less efficient individual power plants for central station current.

Fuel saving in the iron and steel industry has come about mainly through the replacement of bee hive coke ovens by the by-product type.

In connection with the foregoing, it is important to remember that great impetus was given to all these fuel conservation movements by the relatively high and unsettled price of coal during the war and immediate post-war years, which justified the large capital outlay required to effect them.

The question of greatest interest to the coal industry in considering this matter is, "How much farther may this increased efficiency movement go?" The answer seems to be that it will continue indefinitely, but that the rate of increase will be much slower in the future than it has been in the recent past.

The easily and cheaply introduced improvements of design and practice in both locomotive and stationary power plants naturally were made first and subsequent ones tend to be more costly and relatively less effective.

Already electric power from great central stations is distributed over most, if not all, of the highly industralized sections of the country, leaving comparatively few old-fashioned power plants to be replaced. A recent publication of the National Electric Light Association states:

"Every city of 5,000 population or above now has electric service; 97 percent of all communities between 1,000 and 5,000; 50 percent of all communities between 250 and 1,000; and more than 25 percent of all hamlets of less than 250 population."

This is not an unmixed evil. The tremendous public utility companies, with their central power stations, are aggressively engaged in creating and developing new uses for power which could never have been created or supplied by the old methods. This, together with the generally improving standard of living in urban, suburban and rural districts, is steadily and rapidly increasing the consumption of electricity per family.

The iron and steel industries can go but little further in their fuel efficiency program, for about 95 percent of the country's coke now comes from by-product ovens as compared with 60 percent in 1920.

Finally, there is the decreased price of coal which removes some of the incentive for saving it which was so pronounced a few years ago.

Any one analyzing this phase of the situation can hardly escape the conclusion that the tremendous reduction in coal consumption per unit of power in the central station, in the railroad locomotive and in all other large coal consuming plants, has reached a point where further economies will be relatively small and costly. Therefore, normal increase in the demand for power of all kinds should, and, in my opinion, will, shortly result in an increasing consumption of coal for this purpose.

Let us examine for a moment this question of the demand for power or energy in the United States. Mr. Tryon and others of the Bureau of Mines have recently made a comprehensive study of the subject and their findings are of vital interest and quite encouraging to the coal industry. They show that the *total amount* of energy consumed in this country has increased steadily from decade to decade, the average rate of increase over the last 10-year period having been about 700 trillion British thermal units a year, equivalent to some 27 million tons of coal annually.

This showing is still more impressive when it is recalled that Mr. Tryon's figures are based on fixed ratios of fuel quantities to British thermal units and so take no account of the great increase in efficiency of power plants over the last decade, which has just been referred to. Allowing for this efficiency factor, the average increase of energy consumption over the last several years may be represented more nearly by 37 than by 27 million tons of coal per annum.

These figures should bring new hope to producers of such a prime source of energy as bituminous coal, for they give a rational basis for the belief that in this growing industrial country, with a population increase of 17 millions since 1920, a substantial rate of increase in energy demand will be maintained for many years to come, and, as will be shown later, this increased energy demand will, in all probability, be supplied mainly by bituminous coal.

THE second group of causes operating to check the growth of bituminous coal consumption during the past decade, has been the encroachment of other fuels and water power on bituminous coal in supplying the country's demand for energy.

Referring again to Tryon's tables, the percentages of total energy afforded by the principal sources in the United States 10 years ago and last year were as follows:

Bituminous coal furnished 66 percent in 1920 against 53 percent in 1929. Anthracite coal furnished 11 percent in 1920 against 8 percent in 1929. Petroleum furnished 14 percent in 1920 against 25 percent in 1929. Natural gas furnished 4 percent in 1920 against 7 percent in 1929. Water power furnished 5 percent in 1920 against 7 percent in 1929.

Let us now consider the probable effect of these competing sources of energy in the next 10 years.

ANTHRACITE

As a competitor of bituminous coal, anthracite has been gradually declining in importance for some years past. This has been due not so much to a lack of appreciation of its superlative merit as a domestic fuel as to the exhaustion of the better and more accessible anthracite beds in the limited areas of their occurrence in northeastern Pennsylvania and to the consequent rise in cost of production. Substitute fuels, such as oil, by-product coke and manufactured gas, have replaced domestic anthracite to a considerable degree already and will probably continue to do so in gradually increasing amounts. The last two are mainly products of bituminous coal.

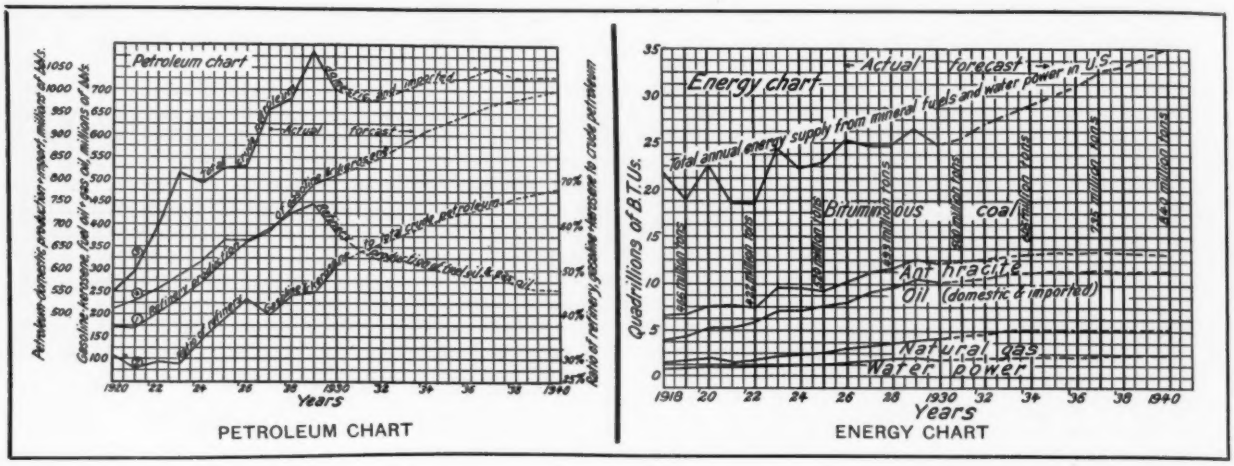
It is very unlikely that bituminous coal has anything to fear from further encroachment of anthracite on either its industrial or domestic markets. The trend is rather in the opposite direction.

PETROLEUM

Petroleum or "oil" is now the most serious competitor with which coal has to contend. The figures quoted a moment ago show that it has captured 11 of the 16 percent of the country's energy production lost by coal—bituminous and anthracite—since 1920. What of the future of this formidable rival fuel?

Now it must be admitted that there is no likelihood of the available supplies of domestic and importable oil being exhausted for many years to come. Such a situation was thought imminent only a few years ago; but recent discoveries and improved methods of prospecting, drilling and extracting have changed this outlook materially.

The cheering aspects of the oil situation to the coal operator are; *first*, the increasing costs which are attending the production of petroleum; *second*, the extremely rapid growth of the use of internal combustion engines in automobiles, tractors, aeroplanes, boats, etc., with their increasing demands for petroleum products—a demand which does not



PETROLEUM CHART ENERGY CHART

seriously lessen the country's need of other fuels.

As to increasing cost of oil production, it is generally known that wells are getting deeper and that in the older fields natural flow is giving way more and more to artificial extraction. Records show that the average oil eld, after reaching peak production, declines in output about 60 percent the first year and 80 percent by the end of the third year. Manifestly, it is essential that new sources of supply be continually tapped to maintain the current oil production, and these sources tend to be more expensive to develop than the ones they replace.

Considering the effect of the rapidly growing automotive industry on oil's competition with coal, it is significant that in the last decade petroleum production and imports have little more than doubled, whereas the consumption of gasoline has increased four-fold. This was made possible by burning less oil in the crude state (that is, refining a greater proportion), and by the development of refining processes whereby gasoline yield from petroleum was increased. In 1920 the gasoline yield was 27 percent, in 1929 it was 40 percent.

Certain refineries are now recovering almost 60 percent of gasoline, and recently an official announcement was made that 80 percent of the refinery capacity of the United States had joined together to use a German process which results in practically 100 percent conversion of crude oil into gasoline.

Now, fuel oil is a by-product from the manufacture of gasoline. The greater the percentage of extraction of gasoline from crude oil, the smaller becomes the available supply of fuel oil to compete with coal. Moreover, the higher the cost of crude oil, the less desirable fuel oil sales become to the refineries.

Thus, since means are now at hand for complete extraction of gasoline to satisfy the ever increasing demand for that product, the forecast seems to be quite well supported that fuel oil will soon cease to be a formidable rival of coal, except for certain special uses where its liquid form makes it particularly desirable, such as bunker fuel. Even here, recent developments in the use of pulverized coal for vessel fuel seem to indicate tremendous possibilities for coal to supplant oil as fuel for the merchant marine.

Production of fuel oil has already commenced to decline. A study of the trends of motor fuel consumption and of gasoline recovery at refineries indicates that there will be no increase above the approximately 450 million-barrel production of fuel and gas oils last year and that a very substantial decrease in their output will be shown by 1932.

THE "Petroleum Chart" accompanying this paper presents graphically several of the elements in the oil situation which have just been discussed. On it the lines recording actual facts up to 1930 have been projected to indicate probabilities for the next 10 years.

For the purpose of forecast, gasoline production figures have been combined with those of kerosene, the two being taken to represent fuel used in internal combustion motors. The *first* assumption has been that the production of these motor fuels will continue to increase at somewhat less than its past 10-year rate for the next decade. The *second* assumption has been that the percentage of gasoline-kerosene recovery from crude petroleum will gradually increase from its present 51 percent to 68 percent by 1940. With these two factors the *third* calculation—total crude petroleum—has been made from the premise that we will produce and import only enough oil to furnish the necessary amount of motor fuel—gasoline plus kerosene. The *fourth*, or fuel and gas oil figures, follow naturally from the three foregoing calculations, after allowing for a few insignificant factors such as lubricants and petroleum burned raw.

Fuel oil has made serious inroads on coal used for domestic heating, but has displaced more anthracite than it has bituminous coal, at least in eastern markets. I believe it is a safe conclusion, for reasons already given, that fuel oil will not improve its strategic position against bituminous coal, but rather that it will henceforth lose ground very perceptibly to its solid competitor.

Natural Gas

Up to the last year or so this fuel was a quite insignificant competitor of coal because there was no great amount of it available in the thickly settled territory east of the Mississippi River where some 90 percent of the nation's coal is produced and consumed. The natural gas of this region was used more or less locally and the output was, and is now, tending to diminish rather than increase.

In the last year or so, however, there has been a change in this situation. The range of distribution of natural gas has increased decidedly; also the quantity used. Wide publicity is being given to ambitious projects for piping enormous quantities of it over long distances from the prolific fields of the southwest to large cities of the central and eastern states. It is reliably stated that there are pipe lines already completed, or under construction or projected from the mid-Continent field to these centers of population which will have a capacity of 1,325 million cu. ft. of gas daily.

This sounds like very formidable competition with coal. But let us look into the matter a little further. In the first place, if worse comes to worst and all these pipe lines are built and all utilized to capacity, their annual gas delivery will be equivalent to only some 18 million tons of coal or 3½ percent of our present yearly bituminous coal production.

Now it is not at all certain that so much gas will actually be delivered. Pipe lines 1½ to 2 ft. in diameter, sustaining a pressure of 500 to 700 lbs. per square inch and having compressor stations every 200 miles, are costly to install and operate. Apparently trustworthy estimates indicate that the proposed twin 24-in., 1,000-mile pipe line from Texas to Chicago will cost $125,000,000 and that the transmission charge alone on the gas handled will be around 25 cents per thousand cubic feet at Chicago. If to this be added the original cost of the gas and local distribution charges, it seems likely that the owners will have to receive, as an average, at least 40 cents a thousand feet for the gas before any management profit can be realized. Now 40-cent natural gas corresponds to medium grade coal at about $10 a ton, which is far above a profitable price for good coal in that city.

In regions distant from the great natural gas fields, certain industries, such as open-hearth steel, glass and heat treating plants, will doubtless find that the special adaptability of this fuel to their particular processes will justify its relatively high cost as compared with coal. But many others—power plants and large heating stations, for example—with mechanical equipment for burning cheap coal efficiently, will find the cost of natural gas prohibitive. Regardless of the glowing prospectuses of promoters, I still maintain that, from the industrial fuel standpoint, natural gas from the far distant fields of Louisiana and Texas will not seriously affect the use of coal in the highly industrialized portions of the eastern United States.

In the realm of domestic heating, gas has a particular appeal because of its cleanliness and ease of control. But here again cost will be an important factor, for gas used in house heating and cooking must bear a 20 to 30-cent higher charge than that for industrial purposes because of large distribution expenses resulting from small scattered points of consumption and irregular demand.

Many wealthy persons will undoubtedly heat their homes with gas because of its convenience and their ability to disregard economy where satisfaction is involved. But these same houses, let me point out, are probably now heated with oil or anthracite, and thus competing fuels will suffer more than bituminous coal from the introduction of gas.

The extent to which natural gas encroaches upon the field of domestic heating now served by bituminous coal will depend entirely upon the success of the coal industry in approximating, at least, the service, satisfaction and convenience of natural gas, by the use of coal.

I am delighted to know from the program this morning that the National Coal Association is thoroughly alive to this fact, and has already taken steps through the Committee of Ten—Coal and Heating Industries—to improve its strategic position in the field of domestic heating.

While a forecast of the future consumption of natural gas in this country can be little more than a guess at present, the probabilities are that it will increase considerably for the next few years and gradually decline thereafter.

Water Power

Water power competition with fuels in the production of electrical energy has increased rather rapidly in the last decade, but even now it is not a large factor, affording in 1929 only 7 percent of the country's energy, or approximately the same proportion as in 1927. Moreover, it is quite apparent that hydro-electric power production will increase more slowly from now on, for most of the large potential sources of cheap water power which existed near the important centers of population have already been utilized, leaving comparatively few which can be harnessed to produce electricity as cheaply as it can be made by steam plants. And every improvement in the efficiency of fuel-burning plants and every reduction in the cost of coal lessens the ability of the undeveloped water power sites to be used economically for hydro-electric energy.

I feel confident that the bituminous coal industry generally has little to fear from the increase of water power plants in this country.

The accompanying "Energy Chart" shows the nation's total annual energy supply from mineral fuels and water power, also the relative amounts contributed by the several principal sources. Here, as on the preceding Petroleum Chart, the graphs show actual quantities prior to 1930 and average estimates for the ensuing decade.

It is not expected that future yearly figures will coincide closely with those in the forecasts, for no one can hope to predetermine temporary fluctuations in industrial activity. But I believe that general trends of energy sources are predictable and that those here shown are well within the bounds of probability.

Summary and Conclusions

From the foregoing discussion the following summary and conclusions seem warranted.

There existed in the second decade of the present century certain well known economic conditions which were beyond the power of the bituminous coal industry to control but which tended to bring about a serious over-development of mining and thereby contributed markedly to the present depression in the coal industry. These conditions have now largely passed and are not apt to recur, at least for many years to come.

Prominent among more recent conditions operating to depress the coal business in the past several years has been increased efficiency in the use of fuels. This greatly reduced the amount of coal consumed per unit of work accomplished, and was an important factor in checking the long-established growth of the country's coal requirements.

Coal-burning industries last year used over 100 million tons less coal than they would have consumed to do the same work 10 years ago. Future improvements in coal consuming appliances will henceforth proceed at a much reduced rate, and soon the steadily growing energy demand of the country will require a somewhat proportionate increase in coal consumption to meet it.

Competition of other fuels and of water power has made serious inroads on bituminous coal consumption in recent years. This phase of our economic development seems to be passing.

Fuel oil has apparently passed its peak production and may be expected to rise in price as well as decline in quantity in the near future.

Natural gas consumption will probably increase sharply for the next few years and then slowly decline. At most, it will replace but a small percentage of the nation's coal output.

Artificial gas and coke may show steadily increasing outputs; but both are products of bituminous coal and will therefore increase its consumption.

Anthracite apparently reached its peak of production several years ago and will make no further inroads on the consumption of bituminous coal.

Water power will not seriously encroach upon coal as a source of energy, due to the cost of developing the remaining possible hydro-electric plant sites.

TAKING all of these things into consideration, I feel there are sound reasons for predicting an early resumption of the upward trend in the country's consumption of bituminous coal. As shown on the chart last referred to, it seems a reasonable expectation that the annual demand for bituminous coal will approximate 600 million tons by 1934, 700 million tons by 1937, and 800 million tons by 1940.

In closing, permit me to caution against drawing fallacious conclusions from this rather encouraging statement. While such an increase in coal demand will be a powerful force in helping to correct the current over-development of the coal industry, a part, at least, of the remedy for (*Continued on page* 901)

The Economic Future of the SOUTH'S MINERALS

By Captain R. M. Watt

KENTUCKY UTILITIES COMPANY. CHAIRMAN, BOARD OF GOVERNORS, SOUTHERN DIVISION, THE AMER. MINING CONGRESS

LONG dormant, and for generations apathetic over its mineral resources, the South first took notice of their value when the late Richard H. Edmonds sounded the note of leadership in the *Manufacturers Record*.

Mining kaolin in South Carolina

One end of a Virginia clay mine

The Central of Georgia Railway began a campaign for the recognition of southern clays, and the industrial departments of the several railroads operating in the South likewise directed their attention to their mineral resources. It is of interest to note that of the American railroads employing geologists the majority are those operating in the South and East.

As the non-metallics achieved recognition, a demand arose for tariff protection against imported clays brought in as ballast or on a joint ocean-rail rate.

With the increased activity in production, came need for ceramists and approved standards in preparation, and institutions such as Georgia School of Technology and North Carolina College of Engineering expanded their curricula to meet the demand.

In the meantime the mountains of western North Carolina and eastern Tennessee, more and more denuded of their forests, became dotted with prospectors; increased interest and inquiry brought geological activity and investigation, and real copper and gold mines reestablished the authenticity of ante-bellum tales of rich metal deposits.

Meeting the demand for more complete data on the South, the American Mining Congress sent its consulting engineer and geologist into the field, and after two years of field work and investigation Dr. Payne's book on the "Undeveloped Mineral Resources of the South" met with gratifying reception, and directed industrialists generally to the great Southern Mineral Empire.

The power companies, recognizing the value of this new line of development, joined with the railroads in the effort to classify the mineral resources in their territory.

State boards of conservation, and development, natural resources and progress commissions, and state industrial boards sprang into being, and the American Mining Congress, through its Southern Division, whose meetings have been held in various cities of the South,

achieved distinct leadership as a coordinating medium in southern mineral development as well as general industrial growth.

Not only because the Kentucky Progress Commission early shaped a definite program, but because of the writer's joint membership on that Commission and the Board of the Mining Congress' Southern Division and his consequent familiarity therewith, a few words indicative of the work in Kentucky may be considered as showing the general trend throughout the South.

For many years the inhabitants of this fertile state have lived in a self-satisfied, contented manner, dreaming of the days of Daniel Boone, Henry Clay, and other illustrious sons. Now Kentuckians have turned their faces to the sun-lit future and Kentucky (which name means "The Land of Tomorrow") has become the "Land of Today." All of these changes came about when, casting politics aside, a Democratic legislature, at the request of a Republican governor, passed a bill to create a state chamber of commerce to be known as the Kentucky Progress Commission and appropriated $50,000 to be used for advertising purposes.

At the first meeting of the 12 commissioners, who represent more than $100,000,000 worth of capital invested in Kentucky industries, their attention was turned to agriculture. A survey showed that Kentucky has 120 counties, and that of this number only 30 counties, or one-fourth of the total, could be classed as industrial because they have factories converting raw materials into finished products or because they are shipping raw materials. The remaining 90 counties are purely agricultural.

The latest available report from the Kentucky State Tax Commission shows that the total state tax receipts amount to $21,869,677, and that of this amount the 30 industrial counties are paying $15,035,805, and the 90 agricultural counties, including a majority of the supposedly rich blue grass counties, are paying $6,833,871. This in face of the fact that Kentucky has expended many millions of dollars of Federal, State and county funds for the advancement of agriculture since 1913, and not one dime for the advancement of industry until the creation of the Progress Commission in 1928.

Another significant fact, brought out by the recent census, is that a majority of the 30 industrial counties show a substantial increase in population, whereas a majority of the agricultural counties show a decrease in population.

A survey made by the Progress Commission shows that 1,400 citizens of one farming county are now living in Detroit, that one-third of the inhabitants of an important industrial Ohio town are Kentuckians, and that one northern factory works under its roof 1,200 Kentucky boys. It is an economic waste for Kentucky taxpapers to spend their money to educate the youth of their land and then force them to stray into exile to seek employment. These surprising figures convinced the Commission that they should turn their attention to an industrial program for a better balance between agriculture and industry.

The Progress Commission engaged the services of the American Mining Congress to ascertain and prepare industrial data on cold, incontrovertible facts rather than peppy slogans and prettily turned phrases. These investigations indicate that Kentucky had advantageous locations with Providence, St. Paul, Minn.; Hastings, Nebr.; Houston, Tex.; Tampa, Fla.; and the eastern seaboard from northern Florida to southern Connecticut within a 600-hundred-mile radius of her border line, with a western border within 80 miles of the center of population, an eastern border within a night's ride of the populous markets of the East, and a northern border closer to Canada than to Memphis, Tenn.

Kentucky has fuel in abundance, being third among all the states in the production of coal and with fast-expanding oil and gas fields, several of the latter providing industrial gas at 25 cents a thousand cubic feet. In addition, electric power plants providing industrial energy at prices in favorable comparison with other states.

These industrial surveys show that Kentucky has 37 minerals susceptible of development besides an abundance of agricultural raw material awaiting conversion into finished products.

Rated first among the states, both in miles of running water as well as navigable streams, Kentucky has a network of railroads efficiently serving every community and is building about 1,200 miles of Federal and State hard-surfaced roads annually without a bond issue.

A recently completed Directory of Kentucky Industries, compiled by the American Mining Congress, develops the fact that more than 20 industries listed are the largest of their kind in the world, 9 are the largest in the United States, and 17 are the largest in the South. This is evidence that Kentucky is an industrial state or these large enterprises could not continue and flourish.

This directory also indicates, by comparison with a previous one compiled about three years past, that Kentucky is especially adapted to certain lines of industry, as evidenced by the increased number of plants as well as by the increased number of employes in the factories previously listed.

This increase is especially noticeable in meat-packing plants, canning factories, dairy products plants, tobacco factories, hosiery and knitting mills, overall and clothing factories, brick, and especially fire-brick plants, wood-working plants of all kinds, and printing, lithographing and rotogravure establishments.

The directory also demonstrates very forcibly that manufacturers are overlooking numerous industrial opportunities.

Kentucky, listed as third among the states in the production of coal, yet with coal by-products plants almost conspicuous by their absence.

Kentucky, right in the middle of the map, within easy reach by rail and water, with communities calling for annually increasing demands for cement, abundantly supplied with limestone, shales, coal and electric energy, yet with only one cement plant.

Kentucky, the proud possessor of high-grade ball, sagger, wad, pottery, and other clays that are being shipped to plants in surrounding states, but comparatively none to home industries.

Kentucky, rich in the best quality of glass sands, in close proximity to low-priced natural gas but without a glass factory.

Kentucky, first among the states in miles of running water, much of it free from undesirable minerals, yet without a rayon factory or other synthetic fiber product plant.

Kentucky, a state that grows hemp and buckwheat, but that can boast of but one small hemp factory and no buckwheat mill.

Kentucky, with deposits of fuller's earth, lead and an abundance of other valuable minerals lying neglected.

These and numerous other industrial possibilities, surrounded by an intelligent class of labor that is only 1.3 percent foreign and only 9.8 percent negro, await the attention of industrial investors to a state that refuses to abandon its reputation for hospitality and its warmth of greeting to the stranger.

The American Mining Congress has also completed an industrial survey of 110 Kentucky towns. This survey gives a mental picture of every phase of industrial opportunity offered by these towns and a greater detail of information for investment seekers than has ever before been listed by Kentucky or any other state.

What has been found true in Kentucky will in similar measure be proven in the other states of the South, varying only in local conditions or nature of resources.

There is still lacking in the non-metallic field a sense of coordination between the source of supply, the processes of preparation, (*Continued on page* 901)

Non-Metallic Minerals

and the U. S. BUREAU OF MINES

WHEN the word "mineral" is mentioned, the average person perhaps calls to mind the widely used industrial metals, such as gold, silver, copper, iron, lead or zinc, or perhaps that important mineral fuel, coal. There are, however, scores of what are usually referred to as the non-metallic minerals, which are highly essential to the industrial and domestic life of the Nation. It is largely upon these so-called non-metallic minerals that we depend for the construction of our highways, dams, bridges, and for our building enterprises generally. They are used to a large extent in our great chemical industries, and they figure extensively in the fertilization of our farms.

Of the total annual mineral production of the United States approximating $6,000,000,000, the non-metallic minerals account for some $4,000,000,000; and, after deducting the $2,000,000,000 represented by the mineral fuels, coal, petroleum and natural gas, there still remains $2,000,000,000, or about one-third of the total, which is made up of the numerous non-metallic minerals to which I refer.

In these highly useful non-metallic minerals there are included asbestos, which, because of its peculiar characteristics, is used for scores of purposes where a heat-resisting material is required; asphalt, used extensively in the surfacing of our far-flung network of highways; and mica, used through a wide field, ranging from electrical insulation to the ornamentation of Christmas trees.

WITHOUT the non-metallic minerals our great construction enterprises must come to a sudden standstill. From clay we derive the brick and tile that enter into building structures of every description—sewers, tunnels, and highways. We depend on cement for the carrying forward of almost every type of building project and also for the surfacing of our roads. Gypsum, another important non-metallic mineral, is the basis of plasters and wallboards. Lime is highly essential to the building industry, and is also used largely in the chemical industries and for fertilizer purposes. Stone, another non-metallic, is used extensively in building projects.

Slate is used for a great variety of purposes, ranging from the roofing of buildings to the schoolboards on which young America scribbles his daily lesson. Sand and gravel are vastly important non-metallic minerals on which the building industry depends.

Potash, phosphate rock, and sulphur are three non-metallic minerals used extensively in replenishing the soil, while sulphur is used in the production of sulphuric acid, called the king of chemicals, due to its extensive use in hundreds of chemical processes. Salt, another important non-metallic, has been described as the only mineral that we eat. Talc is used for a myriad of purposes, ranging from the beautification of my lady's countenance to the manufacture of window shades.

Feldspar and kaolin are used in the manufacture of chinaware; fluorspar in the making of iron and steel.

There are many other important non-metallics, such as barite and ocher, used in paints; garnet and pumice, used as abrasives; and fuller's earth, used in the clarification of oils.

THE United States Bureau of Mines has been able to give notable assistance to American industries in the devising of improved methods of mining and treating these various non-metallic minerals, and in the perfection of methods by which non-metallics of low grade could be so beneficiated as to render them available for the comfort and welfare of mankind. The bureau's activities along these non-metallic mineral lines are centered at its experiment station at New Brunswick, N. J., although notable work on non-metallics has been performed at other of the bureau's experiment stations. It would be quite impossible to enumerate all of the investigative work on non-metallic minerals performed by the bureau, but I will outline a few representative activities.

The Bureau of Mines, in cooperation with the United States Geological Survey, has been charged with the task of finding commercial potash deposits in Texas and New Mexico. To date 17 wells have been drilled in the course of this exploration program. While the particular potash salts that have for so long been imported from France and Germany have not been found in commercial quantities, extensive deposits of polyhalite have been located. Studies now under way give promise that these polyhalites can be so treated as to render them available to the American farmer at favorable prices, thus helping to relieve our farming industry from foreign domination of the fertilizer market.

Through its experimental work with the kaolins of Georgia, Washington and other states, the bureau has demonstrated that American kaolins can be used largely to replace those imported from England and other foreign countries, thus rendering practical aid to the American manufacturer of chinaware.

The Bureau has demonstrated that many of the domestic ochers and siennas in the Pacific Northwest and other regions can be used to replace minerals imported from Turkey and other countries.

The bureau has pointed out ways for the conservation of large tonnages of phosphate rock heretofore wasted in the Florida phosphate mining region.

The fluorspar operators of Illinois and Kentucky have been shown how, by the application of new methods, greatly increased recoveries can be made.

In the field of stone quarrying the bureau has been able to reduce wastes and to show how large quantities of waste material can be utilized commercially. In the slate-quarrying industry it has been estimated that 85 to 90 percent of the raw material is wasted in mining operations. The bureau has demonstrated how, by the use of a novel device, known as the wire saw, the largest part of this waste can be eliminated.

THE bureau is at present conducting a series of studies of mining methods and production costs at representative non-metallic operations, which should be of the most practical benefit to the operators.

The bureau has compiled a large number of information circulars dealing with the technology and economics of the more important non-metallic minerals. These papers deal with clay, barite, gypsum, phosphate, mica, mineral paints, and other important non-metallics. Anyone who may be interested in these subjects is requested to write to the United States Bureau of Mines, Washington, D. C., or The Mining Congress Journal for copies of these circulars.

Opportunities in the mining industry for the young engineer

By

E. A. Holbrook *

IN TALKING with parents and with prospective engineering students, the writer is often asked the question, What are the opportunities in the mining industry for the young engineer?

So far as absolute numbers are concerned, the mining industry can not absorb as many young engineers as can, for example, the electrical industry. That is, assuming that the electrical industries of the country can and do absorb about 2,000 young engineering graduates a year, the total mining industries of the country might absorb somewhat less than one-half of this number. This does not mean, however, that the chances of a young man in the mining industry are only one-half as good as in the electrical industry, for a far smaller number of men in an engineering school take studies fitting them to enter the mining industries. Therefore, in considering opportunities for young engineers in the mining industry, we must consider not only the number of positions available but also the relative number of men available for these positions.

IN STUDYING the development of technical education, both in this country and abroad, it is evident that preparation for the mining industry received early attention. The first School of Mines was the royal "Bergakademie," organized at Freiburg in Saxony in 1778 for the teaching of mining and metallurgy. The second was the "Ecole des Mines" of Paris, authorized by King Louis XIV as a public and gratuitous school of mineralogy, assaying and metallurgy. Thus from the very beginning of our modern notions of engineering and engineering education the mining course has been recognized as necessary to train men for the peculiar technology of mining. It is well to remember that at this time there were no professions of mechanical engineering, electrical engineering, and other more recent branches. The military engineer and the civilian or civil engineer filled the needs of the day, excepting in mining, where the need of specialized training had been recognized. In continental Europe for more than 100 years formal engineering school training has been recognized as a means of preparing young men for the mining industry.

IN GREAT BRITAIN for many years, in the preparation of young engineers for the mining and other industries, more emphasis was placed on the practical training than on formal school training. A young man ambitious to follow the mining industry served an apprenticeship under practical men as the main part of his professional education. Thus the first school of mines was not established there until 1851 (Royal School of Mines in London), and until the beginning of the present century the apprentice system was still strongly emphasized.

In this country for many years we adhered closely to the British plan. As late as 1885 there was much discussion in the Pittsburgh industrial district as to whether or not a young man intending to follow engineering should enter industry without a college engineering training and advance within the industry, or whether a preliminary college training was beneficial to his later professional work.

It is not surprising, therefore, that the American mining industry was organized and first developed without college trained engineers. The first American school of mines was established at Columbia University in 1864. Several other schools were established in the next 30 years. However, the period between 1890 and the World War saw the establishment of schools of mines or mining departments in all of our states where mining was an important industry.

It appears that the graduates from the earlier schools of mines proved their worth first in the metal-mining industries, so that for the past 30 or 40 years technically trained men have been absorbed freely by these industries, the number depending from year to year largely on the degree of prosperity within the industry.

When the writer graduated from a mining course 27 years ago and entered the employ of a small western mining company, he was the first technically trained man to be employed by the company. It was some time before the management could use his training to advantage. Their practical methods were making a profit and for a time it seemed unlikely that a technically trained young man could be of benefit in the business. Today a similar mining company would probably have four or five technically trained men, and I believe would produce their metal less by the trial and error method.

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THE coal industry was developed in this country largely under men of British training. It is not surprising, therefore, that until 30 years ago almost no technically trained men entered the coal-mining industry. However, with the introduction of electrical power underground in the nineties, and its development there until today, it mines and hauls the coal underground and is the almost universal underground power in coal mines, a definite field has been opened for men with electrical and mechanical training. Today the coal-mining industry absorbs an appreciable number of graduates from these divisions of engineering. Since the war, also, the number of mining engineering graduates entering the coal industry has increased rapidly until today I estimate roughly that in the country as a whole about 25 percent of our mining graduates are absorbed by the coal industry.

Thirty years ago practically all technical students intending to follow the mining industry took a general mining course. In their four-year course they took studies in ore and coal mining, in ferrous and non-ferrous metallurgy, in mineral preparation, and incidentally some mechanical, civil and electrical engineering. In those days little or no attention was given to petroleum and natural gas production, branches of the mining industry which today absorb perhaps a greater number of graduates than the older branches.

Today a student choosing to prepare himself for the mining industry must, in general, choose early in his course as among general or ore mining, coal mining, ferrous metallurgy, non-ferrous metallurgy, oil and gas geology, petroleum engineering and petroleum refining. Those who sigh for a return of our old, general, all-around mining course can wish as well for the return of the old, general practitioner in medicine. The body of technical knowledge in the various branches of the mining industry has accumulated so rapidly in the past 30 years that it is a scholastic impossibility to teach something worth while about all these branches in a single four-year course. The oil companies, for example, call for some men trained in oil and gas geology, others trained in geophysics, others trained in production engineering, still others trained in petroleum refining. The only answer possible on the part of the college has been to subdivide and to specialize within the general mining field.

Likewise the mining graduate of 30 years ago might begin his work underground and advance himself in the engineering or in the operating positions there, or upon opportunity he took a job in the mill or smelter and soon became a metallurgist. Today we get calls for metallurgists who are trained in physical chemistry, in metallography, and in other metallurgical work. They can not acquire this training in four years and still have time for studies relating to the mining, civil, mechanical and electrical engineering phases of the mining field.

IT SEEMS clear, then, that the different fields that make up the mining industry today are asking for men of special training of a kind that will supposedly fit them into the definite industry in question. As an illustration, the school with which I am connected, about seven years ago in answer to a particular demand, offered for the first time a four-year course in petroleum refining. I believe that all the students taking this course would, a few years ago, have registered in mining. The success of the new course can be gauged by the fact that every graduate has been absorbed by the rapidly expanding petroleum refining industry. The technical data in this industry is accumulating so rapidly that this year we are giving advanced graduate work in certain petroleum refining subjects.

In considering the chances of an engineering graduate in the mining field today, it should clearly be borne in mind that a far greater percentage of young men go to college than was the case 30 years ago. Many of the leaders in the mining industry today are men without a college education. They are certain proof that a young man can enter the industry and through practical experience and self-education rise to the top. And yet these men are sending their sons to college, and probably they themselves would go to college could they be young again. It seems clear, after a statistical study of boys who are today going to college after high school and those who are not, that the next generation of leaders in the mining industry will be college and generally engineering graduates.

A NUMBER of studies made within the past three years have revealed that the number of engineering students taking the various courses in mining at our American schools have decreased sharply in the last 10 years. Has the demand for men decreased? I think not, considering all the industry. It seems clear that the demand for the general mining engineering graduate has decreased, but, as the number of students has likewise decreased, opportunities in this field are today reported by various schools as greater than the supply.

In coal mining the quietness of the industry for the past two years has slowed up the demand for men, but it is far greater than it was 10 years ago. I also know of a number of graduates in the electrical, mechanical, and industrial courses who have entered the coal-mining industry.

Metallurgy as a distinct profession, while born before the Great War, certainly came quickly to be a lusty child, because of the demand created by war conditions. Since then no industrial profession has made greater strides. Today the total number of men entering the mineral industries through the avenue of metallurgy probably equals those who enter through mining.

PERHAPS the greatest gain in opportunity in the mining field in the past decade has been in petroleum and natural gas. From its beginning up till 1914 these industries were of the so-called practical nature, run by men without formal technical training. Since then not only have a large number of men trained as general mining engineers switched to the petroleum field, but a dozen or more mining schools are preparing men for this field. For several years the greatest demand was for oil geologists, then for men trained in appraisal, more recently the demand for petroleum engineers has developed, and as well for petroleum refining engineers.

In so far as general and coal-mining opportunities for young mining graduates are concerned, I feel that the operating companies should know of the considerable decrease in numbers of students taking these courses, and of the certain shortage of technically trained men they will have to face in the next few years. It is the opinion of a number of mining professors that this shortage of students comes largely from the mining industry failing to offer the young, technically trained men inducements comparable with those offered by other industries. Specifically some of these are:

(a) Many other industries are sending representatives to the colleges and are offering definite training courses in connection with employment with that industry. Operating mining companies, with few exceptions, have offered no similar inducements. This causes students to believe that other industries offer greater opportunities.

(b) The so-called "sink or swim" policy of many mining companies whereby the young technical graduate entering a mining company is left to work out his own salvation, and in many cases apparently is forgotten by the management, shows in an unfavorable light in contrast with those industries that give a young technical employe a training course or an opportunity to change frequently the character of his work during the first year or two in order that he may learn more about the operations of the company.

(c) Many other industries are offer-

ing a higher salary scale to their younger technical men than is the mining industry.

In general, if the mining industry expects to attract the better talent from our technical schools, the individual companies should make their wants known to the college mining departments well in advance, and be prepared to offer a definite change of work or training during the first year or two of employment. On the other hand, it must be recognized and remembered that engineering graduates of the past who have entered and stayed with mining form today a body of successful men, perhaps superior in salary and position to similar groups in many other industries.

GOVERNMENT'S CONTRIBUTION TO MINING

(*From page 889*)

bringing buyers and sellers together to their mutual advantage. New uses are constantly being found for the so-called rare minerals, and the bureau attempts to translate technical developments into terms of commercial supply and demand. Market analyses, with particular reference to the distribution of sales by uses and by geographical areas, are made from time to time, and lists are built up of buyers and potential buyers of the various mine products.

By means of its Common-Metals Division, the bureau studies the economic aspects of copper, lead, zinc, gold, silver, iron, chrome, manganese, nickel, aluminum, tin, pyrite, and sulphur. A noteworthy contribution from this division is a series of economic papers containing summarized data of long-time world production of various metals.

Again, it should be stated that the aim of the United States Bureau of Mines is to help the mining industries. Practical suggestions as to new ways in which this can best be done are always welcome. The results of the various investigations have been presented in hundreds of publications, and in addition the bureau's files contain a mass of unpublished information, which is yours for the asking. I hope that more people will avail themselves of the service that the bureau is anxious to render.

WHAT'S AHEAD IN COAL PRODUCTION

(*From page 895*)

present ills must come from the coal operators themselves. Even with increased demand, the market will not be proof against glutting; much of the demand will still be seasonal; not all mines will be able to operate continuously at capacity, and not all operators will secure an adequate return on their investment.

In other words, the old law of "Survival of the Fittest" will still operate. And by "fittest," I do not mean the *richest* operators, but rather those with well located and relatively low-cost mines, affording good coal; with modern, but not extravagant, equipment; with adequate sales facilities, and with ample cash resources.

Competition will always be severe. Few, if any, of us will live to see the time when, with the vast untouched resources of bituminous coal which this country possesses, certain individuals or companies with more capital than wisdom can not acquire unneeded and high-cost coal mines and proceed to run them at a loss.

But I am persuaded that the future will see no such numbers of "unfit" operators as in recent years have been attempting to force coal from unneeded mines on a reluctant market and thus depressing prices to a point where there was no profit even for those whose coal the country needed and would otherwise have paid a fair price for.

This long period of adversity has eliminated many uneconomical mines. Between 1923 and 1928 the number of commercial operations was reduced 31 percent, and the number of mine employes 26 percent. In the future there will be fewer inexperienced men with a desire to enter the coal mining business in the fond hope that it will yield them a quick and easy fortune.

Moreover, it is to be expected that this period of depression has awakened in surviving operators a keener appreciation of the necessity for economical management, intelligent marketing and a reasonable spirit of cooperation with their fellows.

Whether or not you or your company will be a factor in the industry 10 years from now will depend upon your foresight, acumen, courage and ability to meet constantly changing conditions and methods. But at least it seems encouraging that the general adverse conditions over which you have had little or no control are fast running their course and disappearing, and a better general situation in the industry itself is approaching.

I am convinced we have sound reasons for believing that basic conditions in the realm of bituminous coal will soon enable us to place this great industry of ours upon a much higher plane in the national business world than it now occupies.

Just what we do with our opportunities, remains to be seen.

THE SOUTH'S MINERALS

(*From page 897*)

and the ultimate consumer. New uses and new by-products call for engineering and geological research. But with unexcelled transportation facilities both by rail and water; with power, fuel and labor in abundance, and an awakened sense of industrial cooperation, the mineral industry in the South, led by the American Mining Congress, has assumed gratifying proportions, and will, in the next decade, supply the industrial North and East with its non-metallics and a substantial contribution to the copper and gold, manganese, lead and zinc requirements of American industry.

MOTION PICTURE DEPICTS MINING, PREPARATION AND USES OF ASBESTOS

The mining, preparation and uses of asbestos are visualized in a one-reel educational motion picture film entitled "Asbestos, the Magic Fibre," prepared by the Bureau of Mines, in cooperation with a commercial concern.

Asbestos is a silky, fibrous mineral found in seams or veins in metamorphic rocks. A close-up shows how the fibers of a piece of asbestos may be readily separated by hand. Asbestos fiber does not rot, resists corrosion, and will not burn.

The principal sources of asbestos on this continent are the mountains of Arizona and the area surrounding Asbestos, Canada. A succession of scenes show the process of open-pit mining at Asbestos, Canada. The rock is blasted and carefully combed by hand for the longest and finest fibers. The remaining rock is loaded by steam shovels into dump cars. The following scenes depict the breaking of the large boulders for the crusher by air drills, the drying of the crushed rock in rotary kiln dryers and the screening of the sand and rock from the fiber. Rollers weighing 6,000 pounds crush the larger pieces to silken fiber.

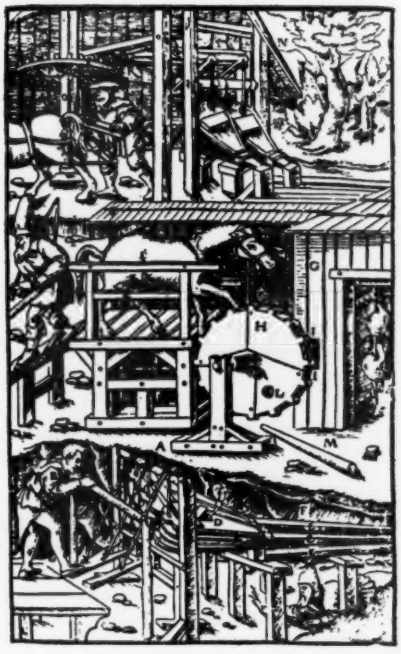
Another scene shows a factory where 20,000,000 pounds of bagged fiber are shown in storage. The crushing of this fiber preparatory to the making of asbestos textiles is depicted.

Other scenes show the combining of asbestos with magnesia for the making of insulating materials, and also the combining of asbestos and cement for the forming of a permanent fireproof material of many uses.

Copies of this film are available for exhibition by schools, churches, clubs, civic and business organizations, miners' unions, and others. Applications should be addressed to the United States Bureau of Mines, Pittsburgh Experiment Station, Pittsburgh, Pa. No charge is made for the use of the film, but the exhibitor is asked to pay transportation charges.

DEVELOPING STANDARDS for metal mines

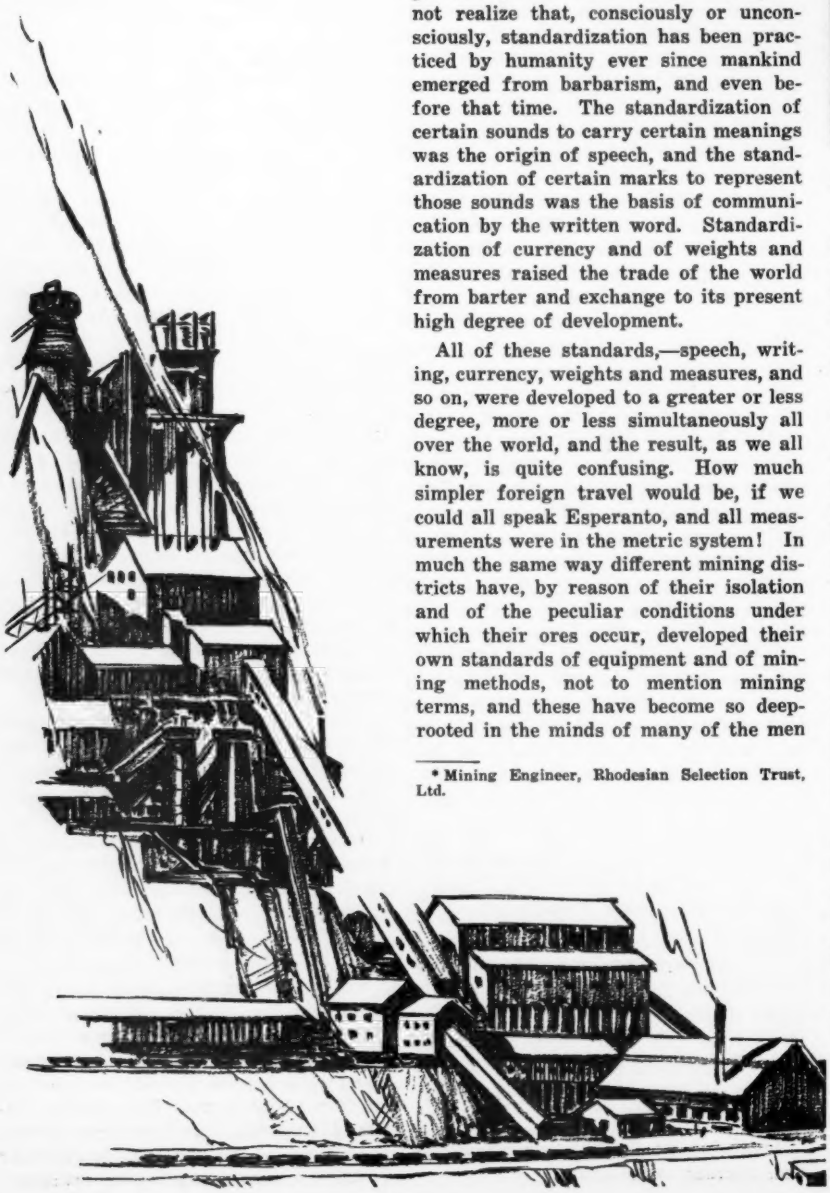
By LUCIEN EATON*



An old woodcut from Agricola, showing a bellows for ventilating a mine

EVEN in these days, when the standardization movement has had so much publicity and has made so much progress in this country, there are people who consider it a new fad. They do not realize that, consciously or unconsciously, standardization has been practiced by humanity ever since mankind emerged from barbarism, and even before that time. The standardization of certain sounds to carry certain meanings was the origin of speech, and the standardization of certain marks to represent those sounds was the basis of communication by the written word. Standardization of currency and of weights and measures raised the trade of the world from barter and exchange to its present high degree of development.

All of these standards,—speech, writing, currency, weights and measures, and so on, were developed to a greater or less degree, more or less simultaneously all over the world, and the result, as we all know, is quite confusing. How much simpler foreign travel would be, if we could all speak Esperanto, and all measurements were in the metric system! In much the same way different mining districts have, by reason of their isolation and of the peculiar conditions under which their ores occur, developed their own standards of equipment and of mining methods, not to mention mining terms, and these have become so deep-rooted in the minds of many of the men in each district, that they are considered to be the proper standards to be used under all circumstances. When, however, they are transplanted bodily to another district and a different set of conditions, they are often dismal failures.



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If the essential principles of these district standards could be separated from the local variations, which are often due to tradition or are the outgrowth of habit, and if a clearing-house of ideas, as it were, could be established, how much simpler it would be to avoid these mistakes and to profit by the experience of others. Just as we know that Esperanto will never be the universal language, so do we know that international standards in mining are impossible. Nevertheless national standards are possible, and the conditions surrounding metal mining in the United States are so varied that national standards adopted here may be applied with a minimum of change to mining in the rest of the world.

About 30 years ago we attained a high degree of standardization in mining practice and equipment in the narrow veins of high-grade ore in our western states, and from these mines the standards spread to other countries, and are found today in many places here and abroad. Since the veins were narrow, and since it was desirable to break as little of the barren wall-rock as possible, narrow drifts were driven, and the cars were made high and narrow to fit the drifts. Small tonnages only of ore were required, and tramming was done by hand in one-ton cars. Ore-passes and chutes were made small to fit (*Continued on page* 905)

Windwheels and fans for ventilating a mine, from Agricola, 1556.

Fulfillment of a PROGRAM for Coal

By J. M. Hadley*

SINCE the memory of man runneth not to the contrary standards have been evolved. Common usage has developed practices, weights, measures, standards of value and standards of quality for commodities, which have come into general use. Some have been codified, others discarded. The indictment that standardization means stagnation, so frequently heard in this generation, hardly holds. Quite the reverse is true, for standardization is dynamic, not static. It does not mean standing still, but rather moving forward. A standard of practice or of equipment represents the best thought of an industry concerned with its use and furnishes the best possible means to eliminate wastefulness and promote efficiency. The desirability of revision is granted, for, as better methods are brought forward and as better machinery and equipment are developed, new standards will take the place of old.

The mining industry started its standards program shortly after the close of the World War. Traveling the rough road of experience, this country had learned that a standard meant something in the purchase of the vast supplies for the world's army. Col. Warren R. Roberts, of Roberts and Schaefer Company, of Chicago, long affiliated with the coal-mining industry, was, during the World War, one of the real standards experts and a member of the staff of the Quartermaster General. His work had been outstanding in eliminating waste and bringing order out of chaos in the purchase of army supplies. The American Mining Congress organized the Coal Mining Branch of its National Standardization Division to standardize coal-mining methods, practice and equipment. Colonel Roberts accepted the appointment as national chairman. The program presented was an ambitious one, which called for sectionalizing coal-production methods. This was brought about through the development of 17 major projects, under the Coal Branch, each properly subdivided and headed by a man who had done conspicuous work along the line under consideration. The idea immediately took root, some 300 men joined in the campaign and amazing results have followed. Committees actively undertook such projects as a standard code for Installing and Using Electrical Equipment Underground, standards for drainage, ventilation, tracks, wire rope, and many others. That was 11 years ago, and the names found on those original committees represent a real Who's Who in Coal Mining today. This article will attempt to tell how, why, and what has been accomplished by this branch of the National Standardization Division of the American Mining Congress.

Consisting largely of coal-mine operators, the original committees had only a smattering of representatives from the manufacturing field. It was early found, however, that many other factors were involved, if the proposed program was to be successful. Immediate reorganization of the committees was undertaken to include representatives of the manufacturers, whose equipment was involved and whose cooperation was essential if the work was to go forward. Further, it was found that the Government was no small factor in the field. Certain recommendations had already been evolved by the United States Bureau of Mines, which were held to tenaciously. When the work finally got under way, the Coal Mining Branch was organized to include (1) the coal-mine operator, (2) the manufacturer of coal-mine equipment, (3) United States Government, (4) representatives of all national associations, including safety organizations, insurance groups, mechanical, electrical and civil engineering groups, and (5) a small number of nationally known consulting engineers for the coal industry.

The work went forward rapidly from that point. Regular meetings were called at convenient places, and through much consultation and correspondence, potential standards were issued and sent to the coal-mining industry. National attention was attracted to them. The American Engineering Standards Committee, later to become the highly representative and effective American Standards Association, issued an invitation to this group to present its standards under, and by authority of, the national standardizing body. Somewhat at sea itself, the American Engineering Standards Committee scarcely knew where its barque was sailing. In fact, it almost floundered, almost sank; but refused to die. Executive leadership and business genius, recognizing the merit of national standardization, rallied to the cause, bringing with them means and new impetus. As a clearing house for mining standardization, the American Standards Association creating the Standardization Correlating Committee. This committee has proved to be the battle ground from which eventually has arisen the group of coal-mining standards that are today the pride of the American Mining Congress, their promulgator and sponsor, and the industry they serve.

From the welter of sweat, brains and determination, and through the cooperation of all these agencies, the industry now has national standards representing the following subjects, approved by the highest standardizing bodies:

* Secretary Standardization Division, The American Mining Congress.

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SAFETY RULES FOR INSTALLING AND USING ELECTRICAL EQUIPMENT—1926

(*U. S. Bureau of Mines and American Mining Congress, joint sponsors*)

COAL-MINE DRAINAGE—1927. REVISED 1930.

TRACKS, SIGNALS AND SWITCHES—1927.

WIRE ROPE—1927.

MISCELLANEOUS OUTSIDE COAL-HANDLING EQUIPMENT—1926.

LADDERS AND STAIRS FOR MINES—1928.

VENTILATION—1929. (Completed but not under A. S. A. procedure.)

Cooperating with other organizations which have acted as the sponsors, the Standardization Division has assisted in the bringing out of two additional standards that have far-reaching effects:

RECOMMENDED PRACTICE FOR ROCK DUSTING, approved in 1928, A. I. M. M. E.

RECOMMENDED PRACTICE FOR THE USE OF EXPLOSIVES IN BITUMINOUS COAL MINES, Mine Inspectors' Institute of America, approved in 1930.

Many projects remain to be completed and many more have been proposed for consideration. Continually new projects are suggested to the division for development. Standards covering the preservative treatments of mine timbers and a standard safety code for coal-mine transportation are now nearing completion. Added to all these, committees are engaged in the development of a standard classification of coals with the American Society for Testing Materials as sponsor; and specifications for locomotives for coal mines, including trolley, storage battery and combination types, with the American Mining Congress and the National Electrical Manufacturers' Association acting as joint sponsors.

The activities of the Mining and Loading Section, of the Coal Mining Branch, of the National Standardization Division, have had especially far-reaching effects. This section in the early stages in mechanical loading development found little that would lend itself to standardization, and therefore confined activities to the collection and dissemination of information regarding successful mechanical loading installation. Out of this activity grew the National Committee on Mechanized Mining now making an extensive study of the subject.

For the time being, therefore, the Mining and Loading Section became inactive and subordinate to the National Committee on Mechanized Mining, but it was arranged that, as the work progressed, and as mechanization became universal, certain items that showed possibilities of standardization should be referred to the section for consideration, development and action. The point has now been reached where it is apparent that several such items have presented themselves. These are:

(1) Standardizing new powder cartridge sizes.
(2) Drill-hole sizes.
(3) Conveyor pans.
(4) Conveyor sprockets.
(5) Conveyor chains.

It is expected that consideration will be given these recommendations at the meetings to be held in Washington, D. C., on December 4, when both the National Committee on Mechanized Mining and the Mining and Loading Section will hold group conferences.

Two new projects to be undertaken in the near future are of particular importance. The first involves the design and details of construction for coal-mine cars, and the other fire fighting and fire prevention methods. In the case of the former, the desire for this standard has long been felt, evidencing itself first several years ago. It resulted in the organization of a committee to do the work. Many obstacles intervened; perhaps both manufacturers and operators not originally connected with the movement feared that it was proposed to limit individuality of structural features. Such was not and is not now the case. The hope is merely for some interchangeability of parts and possibly a decrease of car cost. In this case, rather than call it standardization, we might use the term "abandonment." All will agree that some designs could be abandoned to the benefit of all concerned. The spread of mechanization and the general movement to increase underground operating efficiency demand new types and sizes of cars. Now, it is believed, is the time to arrive at some general standards which new installations can follow. If general agreement can not be reached to standardize the cars themselves, it is certainly worth while to consider the type of standardizing that has been done in automobile manufacture, as evidenced by the following quotation regarding the important standardization effected in this branch of industry. This will suggest immediately to the practical engineer the tremendous possibilities for economies, if only some of the elements of construction of coal-mine cars can be uniformly standardized:

*"The automobile industry is justly considered to be the example *par excellence* of mass production through standardization. The intercompany, or group phase, of this great undertaking, has been carried out in most part through the Society of Automotive Engineers. Their work falls chiefly under two heads: Dimensional details and parts to secure interchangeability.

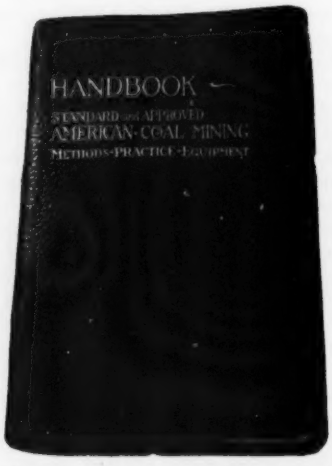
"This includes hundreds of such details as ball bearings, rims, brake linings, gears, brushes, electrical fittings, cap screws, clamps, sprockets, carburetor flanges, gage connections, piston rings, keys, wrenches, spark plugs.

"Specifications for materials which the manufacturer, or the part manufacturer, buys. Under this heading is a group of important alloy steels (which are so numerous that a special numbering system has been devised for convenience in referring to them) specifications for leather substitutes, brass, bronze, copper, zinc, aluminum, and light metal alloys.

"In this large group of standards the idea has been followed throughout that, so far as economically justified, there should be standardization as between companies, of parts, supplies, and materials which are used by the manufacturers, so as to provide as far as possible a common market in which such supplies and parts may be purchased. There has been no effort to standardize cars as such. In fact, there has been a consistent effort throughout to avoid standardizing general designs or any authentic feature, such as car effects, which are a natural basis of competition. Only specifications are standardized that promote interchangeability, eliminate unnecessary variety, facilitate production or servicing, promote safety, or advance uniformity in testing, nomenclature, or operating requirements. Methods of testing are established to aid in disseminating knowledge and in comparing performances. The specifications are not intended to limit individuality unnecessarily.

"Some years ago a group of 50 responsible engineers in the industry cooperated in making an estimate of the economic savings to the industry through such standardization activities. The final figure in the estimate was a saving of 15 percent of the total value of the products, which at that time indicated a saving of $750,000,000 a year."

The "run-of-mine" day at a coal operation witnesses the use of hundreds of standards that are not thought of as such. Several important standards cover bolts, cement, concrete reinforcing spiral steel rods, fire hose and fire-hose



The Handbook is pocket size and looseleaf and is kept up-to-date as new standards are approved.

* P. G. Agnew, Secretary, American Standards Association. From paper presented before the annual meeting of American Trade Association Executives, Niagara Falls, Ontario, September 24-27, 1930.

couplings, machine tools, motor ratings, pipe flanges and fittings, pipe threads, rails, rivets, screw threads for bolts, machine screws, nuts and commercial tap holes, shafting and wire. Seldom, if ever, are these recognized as representing the conscious effort of some organization or group of organizations to standardize. These, as well as the mining standards enumerated above, represent a barrage of heavy artillery that can be effectively laid down to make the enemy position of high production cost untenable. These missiles of modern business warfare should be put to use intensively and intelligently. Many others should be created to follow up. Without many of the standards being used today, the condition of industry would be chaotic. Wasteful variety in design and construction of mining equipment is inexcusable and expensive. Wasteful and unsafe practices are still more expensive and even less excusable. The movement is naturally away from such waste, as a brief look in retrospect at mining conditions will quickly reveal. This movement is being accelerated by the activities of 300 men who are earnestly engaged in the activity of creating coal-mining standards.

The fulfillment of this great program for coal lies in the general adoption and use of the standards by every single coal company in the country, and the interest and assistance of these companies in the formulation of new ones as needed.

STANDARDS FOR METAL MINES

(*From page 902*)

the cars, and worked satisfactorily, because the stopes also were small, and the ore was broken in small pieces. Shafts, slips, and cages were also small, for the small tonnage required could easily be hoisted from the shallow depths mined.

With the exhaustion of the narrow veins of high-grade ores, attention was turned to the large, low-grade ore-bodies, of which the porphyry copper mines are the most conspicuous examples. In order to mine these ores successfully large tonnages had to be produced at low cost, and larger equipment was needed. In order to reduce cost of equipment as well as of production, it was early seen that both equipment and mining methods must be standardized, and much has been accomplished along these lines.

In the Lake Superior district high taxation and low prices for iron ore and copper have compelled the operators to work along the same lines within the limits imposed by the conditions under which their mining must be carried on. The same trend is apparent in other mining districts as is seen in Birmingham, Alabama, and in South-Eastern Missouri.

In the deep mines of the world, even though the ore may be mined in narrow veins or reefs, large units of production and transportation must be used, and a high degree of standardization is required for successful operation.

Probably the highest degree of standardization in the mining industry is seen in the equipment and practice on surface and underground in the Tri-State Zinc District, and the low costs obtained in that district are largely due to this standardization. Other examples of low costs and high development of standardization are seen on the Witwatersrand and in the diamond-mines of South Africa.

The standardization campaign inaugurated and carried on by the American Mining Congress is an endeavor to coordinate the work done in the different districts, so that each may have the benefit of the others' experience, and so that the benefits of uniformity and simplicity in design of equipment and in its use, in so far as local conditions will permit, may be enjoyed by all.

Not content to wait for the development of national standards many of the large mining companies have developed standards of their own, covering different phases of the mining operation. This movement was stimulated by the campaign for industrial safety, and it was found that success in accident prevention was so closely connected with economy of operation that the adoption of operating standards, even though of a temporary character, was imperative.

Probably the first attempt at a national standard in metal mining was the safety code drawn up by representatives from the national societies some twenty years ago. Although this code was not to my knowledge formally adopted, nevertheless it has been the basis of most of the safety rules of the large mining companies. Of late, however, because of the close connection between safety and economical practice, it has been the custom to incorporate the necessary safety provisions in the standards of recommended practice for the different kinds of mining-work.

Although it was one of the first subjects to be studied, it is only recently that a satisfactory standard code for fire-prevention in metal-mines and for mine-rescue work has been completed. This standard has been adopted by the American Standards Association, and is now national standard practice. Standards of practice have also been drawn up for Installing and Using Electrical Equipment in Metal Mines, and are in process of adoption by the Standards Association.

In 1928 a standard of recommended practice for Mechanical Loading Underground was adopted by the American Engineering Standards Committee, predecessor of the American Standards Association. A standard for Underground Transportation was also drawn up and adopted, but the scope of this is to be enlarged, and recommendations of practice are to be added, before it is submitted to the Standards Association for adoption.

Preliminary reports have been prepared on standardization of practice in Methods of Sampling, Recording Geological Data, and Estimation of Ore-Reserves, on Metal Mine Accounting, Drills and Drill-Steel, Mine-Timbering and Timber-Treatment, and Ventilation, and others are in process of preparation. When completed, these standards will form a skeleton, upon which the development and equipment of a metal mine can be based with a minimum of waste in money and effort.

In actual mining practice changes are going on all the time. It is always the endeavor to establish a standard cycle of operations for each twenty-four hours, or for each shift. In drifting it may be desired at first to drill and blast and muck out one round once in twenty-four hours. By speeding up the drilling and mucking, deeper and deeper rounds are drilled, up to the limit of practicability, and then a shorter round per shift is sought, until finally the limit seems to have been reached in two rounds per shift. Standard rounds for drilling in drifts, raises and shafts have been worked out for different kinds of ground and different sizes of opening, and have been given a good deal of publicity, but new ideas are being tried that may make possible deeper holes and larger blasts. The changes in practice are all towards larger units and more rapid progress. Reduction in the number of different ways of drilling a round, in the difference of spacing, direction and depth of holes, will lead to greater efficiency on the part of the miners, and to greater speed in development. Greater speed in development means that development need not be kept so far ahead of stoping, or that safer and better methods of stoping, which require more elaborate development, may be made possible.

By the adoption of standard methods of drilling and blasting, of standard sizes of stopes, standard spacing and sizes of pull-holes, bull-dozing chambers, chutes, and so forth, the work of development and of mining may be divided among groups of men, each of whom is especially skillful along his own lines, and great economies will result. It is not to be expected that such matters can be standardized in such a way that they will suit all conditions, for it is most unusual, even in the same district, to find two mines in which conditions are exactly alike. Mining is an art, not an exact science, but the tools with which we work and the manner in which they should be used can be standardized to a great extent. The application of those standards to the problem in hand must be left to the judgment of the engineer or operator.

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FEDERAL LEGISLATION
for the Mining Industry

By

Hon. Tasker L. Oddie

UNITED STATES SENATOR FOR NEVADA. CHAIRMAN, SENATE COMMITTEE ON MINES AND MINING.

THE mining industry is the keystone in the Nation's industrial arch. The prosperity of the Nation is largely dependent upon the condition of the mining and agricultural industries. While economic conditions in the agricultural industry have been adverse for some time, serious conditions have developed in the mining industry more recently, when the price of the non-ferrous metals, copper, lead and zinc, declined to low levels and the price of silver declined to the lowest figure in history—33¼ cents per ounce on June 21, 1930.

Many of the adverse conditions in the mining industry at the present time are of a general economic character and can be solved best by allowing the operation of the economic law to make the necessary adjustments. There are some problems, however, which are decidedly within the field of Federal legislation.

Consolidations

It was generally recognized over a decade ago that the coal industry of the United States was overcapitalized, overdeveloped, resulting in an intermittent employment of labor which has become more accentuated each year. In other words, there has prevailed, and is now prevailing, in the coal-mining industry cut-throat competition which is neither in the interest of the producers nor of the consumers. Consolidation within the industry would afford considerable relief and a better integration of the producing units with reference to distribution. Because of the limitations imposed by the anti-trust laws this consolidation has been, and is now, impossible legally to effect. I feel that the time has come when the anti-trust laws should be so amended that consolidations could legally be effected in the public interest, and that greater economies in production, greater stability in the employment of labor, and greater benefits to the consuming public would result. There have been opportunities, and these still exist, for consolidations in the copper industry which would bring about similar economies in production and be in the public interest, and these, too, have been prevented under the existing laws. The railroads of the United States, which receive from the mining industry approximately 60 percent of the total tonnage carried, could deliver transportation service at less cost through efficiencies resulting from consolidation and integration with respect to improved distribution, and here again the anti-trust laws have been a serious barrier.

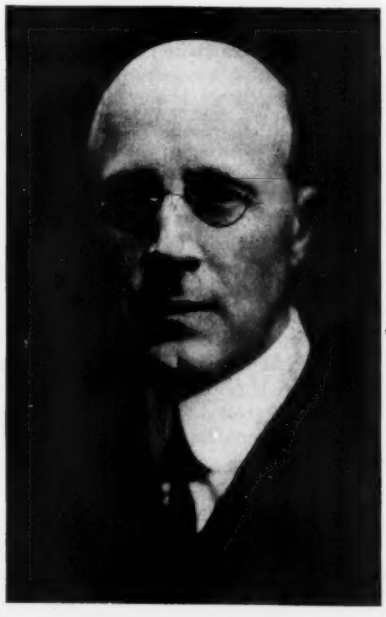
In advocating a change in the anti-trust laws on the basis of greater economy in production and in the services to be rendered by corporations, it will still be necessary to maintain a strong regulatory power, so that the privileges of consolidation will not be abused and become a liability to the public interest.

I was particularly gratified with the speech recently delivered by President Hoover before the American Federation of Labor, in which he said: "It certainly is not the purpose of our competitive system that it should produce a competition which destroys stability in an industry and reduces to poverty all those within it. Its purpose is rather to maintain that degree of competition which induces progress and protects the consumer. If our regulatory laws be in fault, they should be revised." I heartily concur with the President and stand ready at any time to assist in so amending the laws that these economic objections may be fully met.

Soviet Dumping

Not only is there destructive competition by domestic producers of coal in the American market, but the Soviet Government has been a most destructive competitor in dumping coal at artifically low prices in this country.

The manganese industry in the United States, after the enactment of the 1930 tariff, in which the 1922 duty of 1 cent per pound on managenese was retained and extended to ores containing as low



as 10 percent manganese, became very active, and had it not been for the dumping of Soviet ores at artificially low prices in this market, the output of ores from domestic mines in 1930 would probably have exceeded 200,000 tons, or 25 percent of the Nation's domestic requirements. As it is, the domestic manganese industry is shut down, and on account of the adverse effect of the dumping operations of the Soviet Government on both the coal and manganese industries of the United States, I shall introduce a bill early in the next session of Congress declaring an embargo on the importation of these products from Soviet Russia.

Silver Situation

Shortly after the first of this year, when the price of silver was declining so rapidly, I suggested to the Secretary of Commerce that he call a silver conference for December 9, 10, and 11, 1930, in order to give the producers and consumers of silver in the United States and those economists who have so carefully analyzed the American position an opportunity freely to discuss the problem with a view to determining the most constructive remedies. A large proportion of the silver is produced with copper, lead and zinc, and its present low price is, therefore, reflected in adverse conditions in the production of these metals, as well as in the production of silver from siliceous ores. I hope that such a conference will be called at an early date in order to avert still further economic disaster in the non-ferrous metal mining industry.

With a view to increasing the industrial demands for silver, I also suggested to the Secretary of Commerce that appropriations be made available as soon as possible to the United States Bureau of Mines and the United States Bureau of Standards for conducting research, and he has recommended an appropriation of $25,000 for each of these bureaus, to be made available in the next fiscal year.

Constructive remedies resulting in an improvement in the price of silver would go far toward reestablishing normal conditions in the mining industry throughout the Western States and materially increase employment. It is generally conceded now that the great drop in the price of silver has had much to do with the world-wide industrial and economic depression.

The Gold Standard

The gold standard again is under severe attack on the basis that there will be an insufficient gold production 10 or 15 years hence to satisfy the requirements of industry and trade for currency and credit. In 1923-25 I had the honor to be the chairman of Senate Commission of Gold and Silver Inquiry, which conducted an intensive research into the currency and financial conditions of European countries. Many authorities, including Hon. Charles G. Dawes, former Vice President and chairman of the Reparations Commission, expressed the view that this work was most timely and constructive in that it expedited the return to the gold basis in many of the European countries and in the reestablishment of silver currencies. In the last session of Congress I introduced a resolution, S. 261, for the purpose of bringing this research to date and to extend the foreign financial currency and exchange investigation to the countries of Latin America and the Orient. Much can be done through such research in expediting recovery from the present economic depression.

"High-Grading"

Gold and silver miners for many years have experienced difficulty from the practice of "high-grading." A bill introduced by Congressman LaGuardia, of New York, designed to prevent the transportation of stolen property in interstate and foreign commerce, was favorably reported by the House Judiciary Committee in the last session of Congress. This bill offers a most effective means for curbing "high-grading" and should, if enacted, be of great benefit to the gold and silver producers of the West. As soon as this bill is passed by the House, I shall render every assistance that I can in the Senate with a view to its early enactment into law.

Tax Revision

One of the most perplexing problems requiring legislative consideration is to determine a more satisfactory method than exists under the present revenue law for making depletion allowances to the mining industry. I have already called attention on the floor of the Senate to the inequities which are involved under the present system of depletion and to the fact that Hon. Willis C. Hawley, of Oregon, chairman of the Joint Committee on Taxation, has announced a meeting of the committee for December 9, 1930, to take the testimony of the industry on this subject.

Several years ago the oil industry obtained a satisfactory amendment to the present revenue law by adopting percentage depletion. Since that time the oil industry has been particularly well pleased with the rapidity with which its tax liabilities are determined and settlements made. The mining industry would greatly benefit through the adoption of some similar system which would expedite tax settlements and insure equality of treatment to all producers.

The principle of depletion is predicated upon the fact that mining property is a wasting asset; i. e., that when the ore or mineral is removed from the ground the remaining property becomes less valuable. There can be no question that the mining industry in this respect differs from all other industries and should be accorded depletion, but this should be in a form which would insure all producers equitable treatment and so free from complications as to insure a speedy determination of tax liabilities so that prompt settlements could be made. I sincerely hope that the industry will give very careful consideration to this subject so that it will be fully prepared to meet the issue before the Joint Committee on Taxation in a most constructive and helpful manner.

BULK OF SILVER PRODUCTION COMES FROM ORES VALUED CHIEFLY FOR OTHER METALS

Silver production occupies a unique position in the production of metals in that more than half of it is derived from ores valued chiefly for their metals other than silver, according to the Bureau of Mines. The price of silver is thus of less weight in inducing the bulk of silver production than that of other metals associated with it. Only a third of the silver production is derived from ores having silver as a highly predominant factor. On the other hand, the bulk of most other common metals is extracted from ores deriving a large proportion of their value from a single metal, the price of which practically determines the possibility of production.

The recent decline in the price of silver to a record low level has accordingly provoked much inquiry as to the extent to which silver is a by-product of other metals, the extent to which its by-product nature will tend to maintain its production in spite of price, and the extent to which other metal production may be affected by the price of silver. In response to the need for an analysis of silver production data, the output of about 1,000 mines producing 91 percent of the world's silver has been studied by the Common Metals Division of the Bureau of Mines.

Considering the production of silver from a geographical point of view it is interesting to note that North America produces three-fourths of the world's total. In 1928 world production amounted to 257,000,000 ounces, of which Mexico produced 42 percent, the United States 23 percent, Canada 9 percent, Peru 9 percent, Australia 4 percent, India 3 percent, and all other countries 10 percent.

Further details are given in Bureau of Mines Economic Paper 10, "Economic Relations of Silver to Other Metals in Argentiferous Ores," copies of which may be obtained from the Superintendent of Documents, Washington, D. C., at a price of 10 cents.

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LEGISLATIVE REVIEW

CONGRESS resumed activities again at noon on Monday, December 1. This will be the concluding session of the Seventy-first Congress, terminating at noon on March 4. During this three-month period Congress will have a host of problems to consider. Many of these are hold-over measures from the session which closed on July 3 last, while new proposals are expected to be advanced as a result of developments during the past five months. With a new Congress elected in November taking office on March 4 it is expected a disposition will develop to allow that Congress to take care of controverted problems, although its first session will not be held until December, 1931, unless the President calls a special session. The present December session is expected to devote its particular attention to the appropriation bills for the support of the Government during the new fiscal year beginning July 1 next, to measures growing out of the business depression and the unemployment situation, and to numerous matters of a miscellaneous but not highly controversial character.

Several new Senators and Representatives took their seats at the present December session, as a result of the November election, to fill vacancies created by deaths or resignations, and replacing temporary appointees of state governors. These newly seated Senators and Congressmen include the following:

Senator D. O. Hasting, of Delaware, for the term ending March 3, 1931, and also the six-year term immediately following. Senator Hastings has been serving by appointment of the governor, succeeding Senator DuPont, who resigned because of ill health and who died recently.

Senator George McGill, of Kansas, replacing Senator Henry J. Allen, who served in the preceding session under a governor's appointment caused by the resignation of Senator Curtis to become Vice President. Senator Allen was defeated for election for the balance of the term ending March 3, 1933, by Mr. McGill, who will now complete this term of service.

Senator Dwight W. Morrow, of New Jersey, replacing Senator David Baird, Jr., a temporary appointee, for the balance of the term ending March 3, 1931, of Senator W. E. Edge, who resigned to become Ambassador to France, and also for the new six-year term following.

Senator Robert J. Bulkley, of Ohio, succeeding Senator R. C. McCulloch, governor's appointee, for the balance of the term of the late Senator T. E. Burton, ending March 3, 1933. Senator Bulkley was formerly a Representative from Ohio.

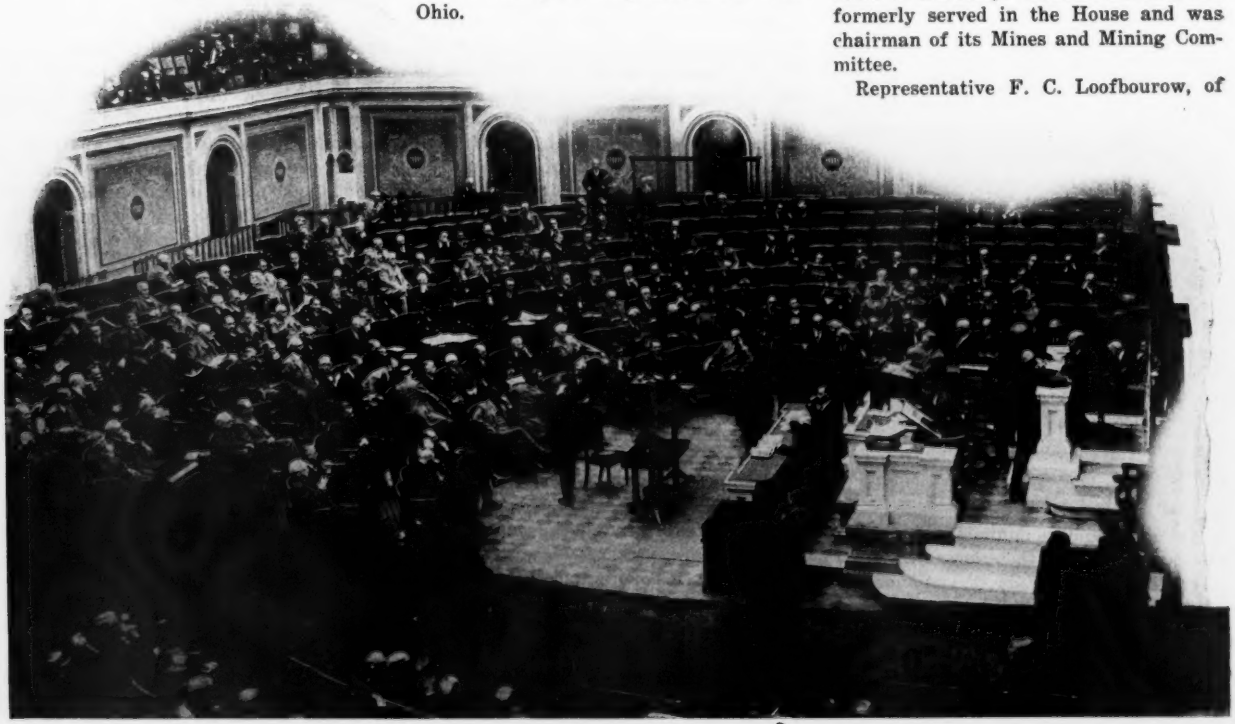
Senator James J. Davis, of Pennsylvania, succeeding Senator J. R. Grundy, temporary appointee, for the balance of the term ending March 3, 1933, to which W. S. Vare was elected in 1926, but who was refused a seat by the Senate. Senator Davis had been Secretary of Labor since March 5, 1921.

Senator William E. Brock, of Tennessee, will finish out the term of the late Senator L. D. Tyson, ending March 3, 1931, having previously served as a temporary appointee, and having been elected in November.

Senator Robert D. Carey, of Wyoming, replacing Senator P. J. Sullivan, a temporary appointee, for the balance of the term of the late Senator F. E. Warren, ending March 4, 1931, and also for the new six-year term immediately following. Senator Carey was formerly governor of Wyoming.

Senator Ben Williamson, replacing Senator J. M. Robsion, temporary appointee, for the balance of the term ending March 3, 1931, of Senator F. M. Sackett, who resigned to become Ambassador to Germany. Senator Robsion had formerly served in the House and was chairman of its Mines and Mining Committee.

Representative F. C. Loofbourow, of



Utah, will succeed the late E. O. Leatherwood.

Mrs. Otis Wingo was elected to succeed her husband, the late Representative Wingo, from Arkansas, for the balance of the term ending March 4, 1931, and the new two-year term immediately following.

Frank Hancock, of North Carolina, will succeed the late Representative C. M. Stedman.

Charles F. Curry, Jr., was similarly elected to succeed his father, the late Representative Curry, from the Sacramento, Calif., district, who recently died.

E. W. Goss, of Connecticut, will succeed J. P. Glynn.

John L. Dorsey, of Henderson, Ky., was elected to fill out the unexpired term ending March 3, 1931, of Representative D. H. Kincheloe, who resigned to accept an appointment by the President as a judge of the Customs Court.

R. L. Rich and E. E. Erk will succeed the late Representatives Kiess and Porter, of Pennsylvania. M. K. Kelly, of Wisconsin, will succeed the late Representative F. R. Lampert.

Representative F. B. Condon, of Rhode Island, will succeed J. E. O'Connell, resigned.

Representative R. L. Hogg, of West Virginia, will succeed the late J. A. Hughes.

New Congressman

On March 4 another and larger group of new Senators and Representatives will take office as a result of the election in November. In the Seventy-second Congress, the first session of which will commence in December, 1931, unless an extra session is called between March and December, the political line-up of both House and Senate will be almost evenly divided. Of the 96 Senators, 48 will be of the Republican faith and 47 of the Democratic doctrine, with 1 representing the Farmer-Labor Party. In the present Senate there are 53 Republicans and 42 Democrats. In the House, after March 4 next, there will be 218 Republicans, 215 Democrats, and 1 Farmer-Labor. As the Republican lists include several of the Progressive type, who frequently line up with the Democrats on major issues, the course of legislative procedure is expected to continue in an uncertain stage. As several months will intervene before the Seventy-second Congress convenes in 1931, the political make-up of Congress may be subject to further changes by deaths or resignations of members. Vice President Curtis will continue to preside over the Senate by reason of his holding that office until March 4, 1931, no matter which party controls the organization of the Senate. Should the Democrats control the Senate, however, they would have the chairmanships and the greater number of members of the committees now held by Republicans. Should the Democrats control the organization of the House, they will elect Representative John N. Garner, of Texas, as the Speaker, replacing Representative Nicholas Longworth, of Ohio, the present Speaker.

New Senators and Representatives who will take office after March 4 next, the Senators for six-year and the Representatives for two-year terms include the following:

Senator John H. Bankhead, of Alabama, replacing Senator J. T. Heflin, who has served more than 30 years in both House and Senate. Senator Bankhead is a son of the late Senator John H. Bankhead, of Alabama, and brother of Representative William B. Bankhead, of Alabama. Senator Heflin had been a picturesque figure and noted orator in Congress for many years, and was denied renomination because he failed to support the Democratic presidential candidate in 1928. He conducted an unsuccessful independent campaign to return to the Senate in the 1930 election.

Senator Edward P. Costigan, of Colorado, succeeding Senator L. C. Phipps, who voluntarily retired. Mr. Costigan was formerly a member of the Tariff Commission.

Senator James Hamilton Lewis, of Illinois, succeeding Senator C. S. Deneen, who was formerly governor of Illinois and who failed of renomination. Senator Lewis formerly served in both the Senate and House and is a picturesque figure in public life. He dresses to the height of fashion, has luxurious pink whiskers, and is a speaker of ability. He defeated Mrs. Ruth Hanna McCormick in the recent election. Mrs. McCormick, who is the daughter of the late Senator Mark A. Hanna, of Ohio, and the widow of the late Senator Medill McCormick, of Illinois, who was defeated six years ago by Senator Deneen, will serve out the balance of her term as a Representative in the House, ending March 4 next.

Senator L. J. Dickinson, of Iowa, succeeding Senator Daniel F. Steck. Senator Dickinson has been a member of the House for several years. Senator Steck had been seated in a contest six years ago with Senator S. W. Brookhart, who in a subsequent election again came to the Senate.

Senator Huey P. Long, of Louisiana, succeeding Senator J. T. Ransdell, for many years a Representative and Senator and an advocate of waterway improvements. Senator Long has announced, however, that he will not come to the Senate until 1932 in order that as governor he may complete certain works started by him.

Senator Wallace H. White, Jr., of Maine, succeeding Senator Arthur R. Gould, who was not a candidate for reelection.

Senator Marcus A. Coolidge, of Massachusetts, succeeding Senator F. H. Gillett, who voluntarily retired. Previous to his Senate service, Mr. Gillett had been the Speaker of the House. Senator Coolidge is no relation to the former President.

Senator Josiah W. Bailey, of North Carolina, replacing the veteran Senator F. M. Simmons, for many years an authority on tax and tariff matters.

Senator Thomas P. Gore, of Oklahoma, succeeding Senator W. B. Pine. Senator Gore formerly served in the Senate, and, although blind, is one of the greatest orators in the country.

Senator James F. Byrnes, of South Carolina, succeeding Senator Cole L. Blease. Mr. Byrnes was formerly a member of the House.

Senator William J. Bulow, of South Dakota, succeeding Senator William H. McMaster. Senator Bulow has been governor of South Dakota.

Senator Cordell Hull, of Tennessee, who will replace Senator W. E. Brock. Mr. Hull has long been a member of the House and an authority on tax and tariff legislation.

Senator M. M. Neely, of West Virginia, succeeding Senator Guy D. Goff, who retired because of poor health. Mr. Neely has also formerly served in both the House and Senate and has opposed proposed legislation to regulate the coal industry.

Senator M. M. Logan, of Kentucky, who will replace Senator Ben Williamson.

The following Senators were reelected and will begin their new six-year terms on March 4:

Joseph T. Robinson, of Arkansas; William J. Harris, of Georgia, who has been active in legislation to restrict immigration from Mexico; William E. Borah, of Idaho; Arthur Capper, of Kansas; James Couzens, of Michigan, who investigated the Internal Revenue Bureau and criticized its tax settlements; Pat Harrison, of Mississippi, principal critic of the administration; Thomas J. Walsh, of Montana, active in the oil lease investigations; George W. Norris, of Nebraska; Henry W. Keyes, of New Hampshire; Sam G. Bratton, of New Mexico; Charles L. McNary, of Oregon; Jesse H. Metcalf, of Rhode Island; Morris Sheppard, of Texas, author of legislation authorizing potash investigations; Carter Glass, of Virginia; and Thomas D. Schall, of Minnesota.

House Members

New members in the House after March 4 will include the following:

Arkansas—John E. Miller.

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Connecticut—Augustine Lonergan and W. L. Tierney.

Georgia—J. S. Wood.

Indiana—J. W. Boehne, Jr., E. B. Crowe, C. C. Gillen, W. H. Larrabee, Glenn Griswold and S. B. Pettingill.

Illinois—W. H. Dieterich, E. A. Kelly, H. P. Beam, L. W. Schuetz, P. C. Granata, J. E. Major, C. A. Karch and K. E. Keller.

Iowa—B. M. Jacobsen and F. C. Gilchrist.

Kansas—Harold McGugin.

Kentucky—C. R. Carden, Brent Spence, Virgil Chapman, Ralph Gilbert, F. M. Vinson and A. J. Moy.

Louisiana—J. O. Fernandez and P. H. Maloney.

Maine—D. B. Partridge.

Maryland—W. P. Cole and D. J. Lewis.

Massachusetts—P. G. Holmes.

Michigan—S. H. Person and J. P. Walcott.

Missouri—J. H. Shannon, C. C. Dickinson, S. C. Major, Clyde Williams, J. F. Fullbright and W. E. Barton.

Nebraska—Malcolm Baldridge, J. N. Norton and A. C. Shallenberger.

New York—C. D. Millard and W. G. Andrews.

New Jersey—W. H. Sutphin and P. A. Cavicihia.

New Mexico—Dennis Chavez.

North Carolina—Walter Lambeth, A. L. Bulwinkle and Zebulon Weaver.

Ohio—B. B. Harlan, F. C. Kniffin, J. G. Polk, W. M. White, A. P. Lamneck, W. L. Feisinger and Chas. West.

Oklahoma—W. E. Disney and F. B. Swank.

Oregon—C. H. Martin.

Pennsylvania—P. J. Boland, Norton Lichtenwalner and H. L. Haines.

Tennessee—O. B. Lovette, J. R. Mitchell and E. H. Crump.

Texas—Martin Dies, Jr., and R. E. Thomason.

Vermont—John E. Weeks.

Virginia—T. G. Burch, J. W. Fishburne, Howard W. Smith and J. W. Flanagan.

Washington—R. A. Horr.

West Virginia—L. S. Horner.

Wisconsin—G. R. Withrow and J. B. Beileau.

Russian Imports

Efforts will be made during the session to exclude imports from Russia because of the alleged policy of that country to break down American industries by the dumping of goods at less than cost of production. The matter has been investigated by a special committee of the House, headed by Representative Fish, of New York, which is expected to submit a report. The House Committee on Ways and Means will receive from various Government agencies reports as to the Russian imports in connection with a bill by Representative Brumm, of Pennsylvania, to exclude anthracite from that country. Senator Oddie, of Nevada, has announced that he will introduce the following bill to exclude all imports from Russia:

"That the transportation into the United States, or any territory subject to the jurisdiction thereof, of any article or merchandise (1) from any territory subject to the jurisdiction or control of the Government of the Union of Soviet Socialist Republics, (2) mined, produced or manufactured wholly or in part in any such teritory, or (3) produced or manufactured from materials, any of which have been mined, produced or manufactured in any such territory, is prohibited. The Secretary of the Treasury is authorized and directed to prescribe such regulations as may be necessary for the enforcement of this act."

Regulation of the natural gas industry by the Interstate Commerce Commission will be proposed in a bill to be introduced by Senator Capper, of Kansas.

Senator Norris, of Nebraska, will seek action by the Senate on the bill of Senator Shipstead, of North Dakota, to forbid the issuance by courts of injunctions in labor disputes.

Conferences were resumed by the House and Senate on the Muscle Shoals, Alabama, nitrate and power project with a view of completing this long pending question. At the last session bills were passed by both Houses, one by the Senate for Government operation of the project and the other by the House to authorize its lease, but the conference committee was unable to adjust the matter.

As the present session of Congress was fully organized to do business, no time will be lost in resuming legislative procedure following the July recess. The House plans to proceed at once with the appropriation bills and the Senate to consider miscellaneous matters. The House was prepared for the appropriation bills by its Committee on Appropriations, which in November began their formulation.

On December 9 the Joint Congressional Committee on Internal Revenue Taxation will hold a hearing on the question of percentage depletion for mines at which views will be presented by the Treasury Department, which administers the tax laws, and the mining industry, which is deeply interested in the matter. Other tax matters to be considered by Congress will be the question whether the 1 percent income tax reduction granted this year on 1929 incomes shall be allowed for 1930 on returns to be made on March 15, and a proposal to repeal the tax on capital gains. President Hoover, in a recent address, suggested an investigation of the capital gains tax on the ground that this tax "encourages inflation by strangling the free movement of land and securities."

BUREAU OF MINES REVIEWS YEAR'S WORK

The varied activities of the Bureau of Mines during the year ended June 30 last are reviewed by Director Turner in his annual report.

The report shows that more than 112,000 employes of the mining, quarrying, metallurgical, oil and gas, and allied industries were trained in first-aid or mine-rescue methods during the fiscal year ended June 30, 1930. The number surpasses by 31,000 that attained in any previous year, bringing the total number so trained by the Bureau since its establishment to approximately 480,000.

Continued widespread interest was manifested by the mining industry in the numerous reports on mining and milling methods and costs issued by the Bureau. These reports present detailed data regarding conditions at representative operations in the various mining districts, and are designed to assist the operators in the solution of their economic problems. This work was extended during the year to the non-metallic industries. Studies in geophysical prospecting were continued, an important feature of this work being the issuance of monthly abstracts of the world's literature in this interesting field. Problems of mine subsidence and mine ventilation also received attention.

The Bureau continued to take an active part in the technologic progress of the metallurgical industry, seeking to focus attention upon wasteful or inefficient practices, pointing out improvements, and obtaining the cooperation of producers in adopting better methods and putting into use more efficient devices. The Bureau is providing fundamental metallurgical data which are vital to the progress of metallurgy.

Director Turner states that studies in the microscopy of ores are proving valuable in the treatment of the complex ores of the intermountain region and that new light is being shed on the metallurgy of copper, with special attention to leaching problems. Lead and zinc operators of the Mississippi Valley are being aided in the solution of their milling problems and studies are being made of the lead blast furnace to develop information on smelting processes. Studies are being conducted to develop a domestic chrome industry. Special attention has been given to problems affecting the phosphate, kaolin, mica and ocher industries. New processes for using potash from New Mexico and Texas for fertilizer purposes are said to promise success.

Roof Action

IN NEW MINING SYSTEMS

By G. B. Southward

Our present methods of roof support have been determined by trial and we do not have definite formulas or knowledge to calculate or predict with accuracy what the roof action will be in a new mining method. A correlation of data on existing operations will increase our knowledge

THE subject of roof action is becoming increasingly important in connection with changes and modifications in the mining systems that are being tried and proposed for use with mechanized loading. The problem of holding the roof is always present to some degree in every mining operation from the time that the first entry is started underground, and its difficulty increases in direct ratio to the percentage of coal extracted. In the type of room and pillar mining where there is enough coal left in the pillars to prevent surface subsidence the roof support is comparatively simple. The weight of the overburden is distributed more or less equally over a number of pillars and in the open workings the only support needed is for a few feet of rock directly over the room or entry. Without having any additional weight or pressure from the general overburden, the strength of the roof is usually sufficient—when reinforced by light timbering—to span the opening as a beam supported by the coal in the pillars between the rooms. As the percentage of extraction is increased, the point is reached where the beam does not have this strength or else the coal pillars are not able to carry the weight of the overburden, and it is then that the real problem of roof action begins.

When a complete, or nearly complete, extraction of the coal is made one of two things must take place. An artificial support must be provided capable of holding the overburden or else the strata over the mined areas must cave or subside. Theoretically it is possible to replace the coal with some material of equal bearing strength—reinforced concrete if necessary. To do this would, of course, be impractical from a cost standpoint, and the closest approach to a complete support so far designed or used is made by backfilling the mined areas. This method is practiced quite widely in European mines and to some degree in the anthracite mines of Pennsylvania, but in the bituminous fields of the United States the market value of the coal will not permit the expense.

The use of packwalls in long-face mining has been proven practicable for bringing about a gradual subsidence in the mined area behind a continuously advancing working face. This method is used successfully in the United States, but the cost of building packwalls has limited it to a small number of operations. The advantages of long-face mining with mechanized loading are so attractive that a good many attempts have been made to use this system, but to substitute for the expensive packs a cheaper form of support, such as timbers or cribs. The roof is made to cave rather than to bend and gradually subside, and under favorable conditions these methods are successful. In other instances they have failed. The successful operations prove that the use of packwalls or backfilling is not always essential in long-face mining; this is particularly true in systems which are not designed to make a complete extraction but leave a small percentage of solid coal as a temporary roof support.

In designing a mining system and a method for caving or subsiding the mined area there is too often a tendency to base the design upon conjecture or assumptions. There has been a great deal of money spent in trying to bring about a predetermined roof action, and there have been a number of failures caused by trying to control the roof according to plan rather than in accordance with what the physical conditions will permit. When a company first attempts a new or modified system in an unknown field, it would be very advisable for the men in charge to eliminate the words "roof control" from their vocabulary and realize that when complete or nearly complete mining is attempted the forces exerted by the overburden are so great that any control we may exert over them is actually very limited—about to the same degree that a sailboat controls the wind.

When a new mining system is tried, it is very apt to involve an unknown roof action. The mining systems as operated with hand loading have been determined by trial without the necessity for a great deal of thought or scientific investigation as to what was taking place in the rock measures above the coal. There have been several theories formed to explain the behavior of the overburden when a complete extraction of the coal is made, but these are not well enough established to determine definitely what the roof action will be for a new mining system or a new method of roof support.

In a certain sense the questions which arise in designing a method of roof support are very similar to those encountered in construction design. An engineer would not plan a building without knowing the load it had to carry, the strength of the materials used, or without following proven formulas. If the construction involved an unknown material or stress, there would be experiments made to determine this factor before it would be incorporated in the structure. In mining we do not have this definite knowledge, and, until we know more about the forces and the stresses set up in the roof strata, we must necessarily experiment to determine the results which we are not yet able to calculate or foresee.

Certain factors are known to affect the roof action. The depth of cover, the character and thickness of the strata, the pitch of the seam and the thickness of the coal all have some bearing on what will happen when the coal is mined out. The mined area necessary to give a minor fall and that required for a complete cave are two of the most important questions to be considered in deciding how the recovery shall be made.

There will be much study required before we know the exact value and effect of each of these factors or before we can definitely say what system of mining and what method of roof support will be most suitable for any given set of conditions. But in the meantime there are enough successful methods which can be correlated and compared to indicate what results may be expected and what general line should be followed when a departure from standard practices is to be made.

(This article introduces the subject of roof action and detailed descriptions of different methods of roof support will appear in subsequent issues of the Journal.)

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COAL

NEWELL G. ALFORD
Editor

Practical Operating Problems of the Coal Mining Industry

Mine VENTILATION

By L. W. Huber*

THERE is no use in talking about the importance of ventilation, as it is well known that good ventilation is absolutely essential for the safe operation of a coal mine. In fact, we can not operate at all without it. Two important functions of a good ventilation system are: (1) To supply plenty of good, fresh air, so that men can work safely and comfortably, and so that all explosive and noxious gases are immediately diluted, rendered harmless, and swept out of the mine as quickly as they are given off; (2) to do this as cheaply as possible. With market conditions as bad as they are, this second consideration is very important, yet most mines are wasting plenty of money on ventilation without accomplishing good results.

As a consumer of power, ventilation is as important as any of the major operations of coal mining, such as haulage, mining, pumping or hoisting. A survey of the power consumed in Illinois coal mines,† made in 1923, segregated the power consumption of the five major operations in coal mining in 50 different representative mines with the following results:

	Percentage of total power consumption
Haulage	23.0
Ventilation	22.2
Mining	22.1
Hoisting	17.2
Pumping	5.0
Miscellaneous	10.5

It is readily seen that ventilation required and consumed almost as much power as haulage and more than mining—by mining is meant coal cutting and drilling. It is no uncommon thing to see mine operators go to considerable expense to provide good, heavy track with minimum grades and curves for haulage, and this is mighty good practice—it would be fine if we could see more of it, but practically never do we see any body cleaning up airways or cutting out sharp curves and abrupt bends in airways so as to provide a nice, big and smooth passageway for air to travel. Why not? Because very few mining men realize how expensive ventilation is or that poor ventilation is considerably more expensive than good ventilation. The high-power cost of ventilation can readily be appreciated when it is considered that ventilating fans run 24 hours a day and, except in cases of protracted shutdowns, 365 days a year. This is as it should be, all right, for it would be very foolish and dangerous economy to shut down or slow down a fan and allow explosive gas or dead air to accumulate. If there is anything around a coal mine which does and should operate continuously it is the ventilating fan. Because of this steady operation, it can be considered that ventilation horsepower, saved or expended, is worth three or more haulage or mining horsepower, since motors or other power units driving fans run three or more times as much as those used in haulage or mine operations.

Another consideration which illustrates the importance of ventilation is that the average coal mine handles over three times as much air by weight as it does coal. If it is assumed that a mine producing 1,000 tons of coal per day requires 50,000 cu. ft. per minute, that the average weight of a cubic foot of air is .075 lb., and that the fan runs seven days per week while coal is produced (during good times in the coal business) six days per week, a 1,000-ton mine in a week's time will require 18,900 tons of air and will produce only 6,000 tons of coal, or 3.15 tons of air per ton of coal.

Air has weight and inertia, just the same as water and other substances, and it takes power to move it and to keep it moving. It takes power to overcome resistance offered to the flow of air because of friction of the ribs, roof and floor entries as well as other obstructions. Every time we kill the forward velocity of an air current or abruptly change its direction, we waste power in that inertia has to be overcome in bringing the air up to its former velocity. Everyone will agree, I think, that it takes a lot more gasoline and power to drive an automobile through traffic,

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†Arthur J. Hoskin & Thomas Fraser: "Power Studies in Illinois Coal Mining." University of Illinois Eng. Experiment Station Bulletin No. 144.

where it is frequently stopped and started, than it does to drive it the same distance along a straight, smooth road without stopping, or, as we say in terms of ventilation, killing its forward velocity.

All rough curving and timbered airways offer considerable resistance to the flow of air, and the fewer of these we have the better and cheaper our ventilation will be. I don't mean to say that it is necessary or even advisable to go to great expense to straighten out all airways if they are already driven, but it is just as cheap, easy, and quick to drive airways straight in the first place, and it is a mistake to drive entries in a careless, slipshod manner just because it is understood that they are to be airways.

Very frequent offenders in causing unnecessary mine resistances are ridiculously small area overcasts. The area of the passageway through which air is to travel at any part of the overcast should be just as great as the area of the airway leading to or away from the overcast. If this is not true, unnecessary resistance to ventilation is built up. Air should be conducted up to, over, and away from an overcast in a smooth, sweeping curve. The slight extra expense necessary to shoot down roof and fill in on each side of the overcast to accomplish this is gotten back in power saving in a very short time.

Some large, progressive companies have deemed it advisable to leave track in airways, so that airways may be easily kept clean at all times and all falls loaded out as soon as they occur. I have no hesitation in saying that airways should, by all means, be kept clean. Whether or not it would pay to keep track in airways as a general practice, however, depends entirely on roof conditions, price of steel and labor, and the financial condition of the company.

The simplest, and by far the most costly, way to ventilate a mine is by means of one long, continuous current. Any boy, with the aid of plenty of doors and curtain checks could lay out the plans for such a system of ventilation. One who understands ventilation, however, knows that the horsepower required varies with the cube of the velocity of air travel, and that it pays to provide airways of large area, to split the air and ventilate with as low velocity of current as possible, even though it does require a few overcasts.

Cheap, leaky stoppings are further important causes of poor and expensive ventilation. Evidently few realize the importance of tight stoppings, or we wouldn't see so many leaky ones. Few men would try to pump water out of a mine with a leaky pipe line which allowed 60 percent of the water to squirt out and filter back to the pump, yet exactly this is done in many ventilation systems. An investigation made some years ago in a group of representative mines by the U. S. Bureau of Mines showed that on 40 percent of the air delivered by the fan was being delivered at the face. Sixty percent of it was leaking through stoppings and doors, overcasts, and short circuiting back to the fan. Stoppings and doors are put in to stop the flow of air through entries, cross-cuts, or break-throughs; if they leak, they are inefficient and costly and cause a lot of useless work and expenditure of power.

***TOO MUCH STRESS** cannot be placed upon the need for adequate ventilation and proper means of obtaining it. A representative committee of the Coal Mining Branch of the National Standardization Division of the American Mining Congress has completed an excellent set of recommendations on the subject and over four thousand copies have been distributed. Definitions; maps; supervision and responsibility; reports; intakes and returns; overcasts, stoppings, doors and brattices, air quality and quantity, safety lamps and fan selection, installation and operation are covered. A similar committee is engaged in work for metal mine ventilation.*

When a man installs a booster fan in a mine he, in effect, says: "My ventilation system is a failure, and I have to stick this thing up here to help out." Of course, there may be some conditions which might justify the installation of a booster fan for a short time as a temporary help, but these are few and far between. Usually the installation of such a fan is an admission of defeat and lies along the path of least resistance. It is, apparently, an easy way out, but in the long run is costly and sometimes even disastrous. A booster fan requires a motor of its own, and every motor not necessary to the safe and efficient operation of mines is an additional hazard underground. A booster fan does boost the pressure a little when running—when it stops, it blocks up the entry and offers considerable resistance to the flow of air unless an automatic by-pass is installed with it. Such a by-pass is expensive to put in and is very seldom used. In case of a fire or an explosion underground fans are of no value at all—usually we wouldn't dare start them up even if they were not damaged and we could get to them.

Another underground fan I have no use for is the auxiliary blower. This is usually a small centrifugal fan used with flexible tubing. If these fans are installed in fresh air, so that no return air passes over the fan itself (they necessarily have to be blower fans when used with flexible tubing), they are safe while they are running. They each require, however, another motor underground and are usually installed so that they do a good job of mixing and churning rather than ventilating. They have, to my knowledge, been the cause of at least five serious explosions and are, in my opinion, undesirable makeshifts.

All fans should be on the outside, where they can easily be taken care of and are safe. If, however, underground fans are used, they should be run continuously the same as the primary ventilating unit. Any interruption in ventilation is serious and should be carefully guarded against. It is surprising how quickly methane accumulations build up, even in "non-gaseous" mines, when steady ventilation is interrupted. Those who have no fear of gas accumulations because their mines are "non-gaseous," should remember that almost all of our explosions happen in so-called "non-gaseous" mines.

Volumes have been written on the advantages and disadvantages of blower and exhaust systems, so I'm only going to touch on it. Personally, I much prefer the exhaust system for all coal mines, since this ordinarily puts the main line haulage on the fresh-air intake and keeps return air away from open lights, most short circuits, and electric arcs, and makes it much easier to get into and out of mine without changing the ventilation after an explosion or mine fire.

Worked out sections should be either sealed off tightly or well and continuously ventilated. (*Continued on page* 924)

The problems of a State Mine Inspector

By W. B. HILLHOUSE*

IN Alabama there are in regular operation 230 coal mines, which are opened on 30 different coal seams, the openings being drifts, shafts and slopes, the latter predominating in number. These seams vary in thickness from 20 in. to 7 ft., and lie from horizontal to an inclination of 65 degrees. The strata lying directly over the coal seams vary from a soft shale to a firm sandstone. Methane gas is given off in 40 percent of all operations, and ranges in quantity from 20,000 cu. ft. to 1,400,000 cu. ft. every 24 hours. Some of the mines are naturally wet, but in the dry mines the application of water or water and rock-dust is practiced for the suppression of coal dust. Rock dust when used is applied in quantities to render the coal dust harmless.

In Alabama, as in other coal producing states, the paramount problem, in so far as the state mining department is concerned, is the preservation of human life and limb. In the pursuit of this end, we also endeavor to help constructively with suggestions for the better physical and economical mine operations. Consistent with safety, we are always careful to avoid suggestions entailing unnecessary expense. It is quite gratifying how the mine officials have come to receive and act upon these. This is, of course, as it should be, because certainly we are all "in the same boat."

COOPERATION must, of course, always exist among all persons having to do with the operation of the mines, as otherwise good results can not be attained. It goes without saying that this is just as true in mining as it is in other lines of human endeavor.

Perhaps our Alabama Mining Department has an advantage over many others of like nature in that its activities are confined to eight counties with the city of Birmingham which is headquarters for the state mining department as well as most of the mining companies in the center of that area. By reason of this location close personal contact exists between the mine managements and the head of the state mining department. Such close contact brings about frequent and friendly consultations covering the many features of the work, and results in continuous and friendly association of great benefit in every way to our mining industry. In like manner the associate inspectors make their examinations in a spirit of friendliness and helpfulness, and not in a spirit of antagonism or criticism. Working from both ends in this manner, the spirit of cooperation which exists all along the line goes far to promote the safe and efficient operation of the coal mines in Alabama.

IN Alabama, as in other coal producing states, the principal sources of injury come from roof falls, ignition of gas, transportation, and electricity, and the substantial reduction of accidents from these sources is regarded, of course, as our outstanding problem.

Roof falls are responsible for approximately 45 percent of the mine fatalities throughout the United States. The mining department of the State of Alabama has been and is endeavoring to reduce the accidents from this particular mining hazard. Realizing fully that the visits of the state inspectors to individual working places (where 80 percent of these accidents occur) are not, and in the natural order of things, can not be made often enough to render much direct aid, a special educational campaign for the reduction of accidents from falls of coal and roof was inaugurated.

Wide distribution of circular letters was given. These letters were posted on bulletin boards or other conspicuous places at the mines. They dealt entirely with the hazard from coal and roof falls, and created such great interest as to bring about much beneficial discussion amongst the miners. Following these letters, men prominent in mining affairs were induced to address meetings at the various mines. They confined their remarks to that subject alone, stressing the importance of the individual miner always exercising the necessary care to take down all loose or overhanging material, or promptly place necessary timbers where and when needed. Cash prizes were awarded mine officials and state inspectors for the best essays on "Prevention of Accidents from Roof Falls."

Great interest was created in this manner, and it still exists. The very satisfactory results achieved bespeak the decided effectiveness of our efforts. Fatalities from roof falls in Alabama mines since August, 1927, at which time the campaign began, show a very gratifying decrease compared with preceding years. A lower fatality rate is now shown, based on tons mined, than the average for the United States. In all mines systematic timbering rules should exist, and be enforced whether the roof is good or bad, and independent of the timbering rule, the miner should place additional props where the roof conditions warrant it.

The following figures show the wonderful effectiveness of the drive:

Year	Fatalities	Tons mined per fatality
1924	39	502,973
1925	42	483,920
1926	49	438,955
1927 *	61	330,999
1928	28	644,861
1929	28	657,711

* Campaign on roof-fall fatalities began August 15, 1927, and prior to that time 48 lives had been lost during the year.

This problem is far from solution, but if the adoption of systematic timbering becomes general, with closer supervision of roof conditions by the foreman through daily or more frequent visits, and greater care on the part of the miner himself, much more can be accomplished.

THE mining laws of the State of Alabama stipulate a quarterly inspection of each coal mine, but going beyond this requirement, the inspection department has for the past three years made monthly inspections of all gassy mines. With a period of three months between inspections, many things can happen in many mines which will lead to serious trouble. If such mines, however, receive monthly inspections, sub-normal conditions can more easily be found and the remedy applied before an accident happens. We find that our extra precautions of this kind frequently find and bring about removal of hazards which otherwise would exist for an additional 60 days. (*Continued on page* 916)

* Chief, Department of Mines, Birmingham, Ala.

Presented to 19th Annual Safety Congress, Pittsburgh, Pa., October 3, 1930.

The problems of a State Mine Inspector

By WALTER H. GLASGOW*

THE basic principles of the mining laws of the Commonwealth of Pennsylvania are set forth in the preamble to the acts covering the operations of both anthracite and bituminous regions, to wit: "To provide for the health and safety of persons employed in and about the bituminous (anthracite) coal mines of Pennsylvania and for the preservation of property connected therewith."

These laws have been compiled, from time to time, from the records of the best practice known since mining has been recognized as a scientific pursuit, and cover in detail all phases of mining. It can be truly said that they constitute in reality an authoritative textbook on safety in this great industry.

The enforcement of these laws is delegated to the state mine inspectors through the administrative office of the Department of Mines. These inspectors are appointed by the governor from a civil service list and are endowed with police powers. As the powers granted them are very broad, responsibilities are accordingly heavy and naturally problems of a numerous, varied, and at times complex nature arise to confront the inspector in the performance of his duties, as each matter of omission or commission in conflict with the mining code sets up a definite problem.

Should the inspector interpret and enforce literally the laws as set forth in the mining code, his duties would be very perfunctory, but the legislature has issued mandatory instructions that the inspector shall exercise a sound discretion in the performance of his duties under provision of the act. It is this discretionary power granted to the inspector that creates a problem for him when there is a departure from the standards as set forth in the mining code.

General Rule No. 1 of the Anthracite Mine Law, for instance, breathes generously of the spirit of the makers of this law when it gives utterance to these words:

"The owner, operator and superintendent of a mine or colliery shall use every precaution to insure the safety of the workmen in all cases, whether provided for in this act or not."

Article XX—Section 1—Bituminous Mining Law says:

"The inspector shall exercise sound discretion in the performance of his duties under the provisions of this act."

THE ideal mine inspector is not only to comply with the law but go beyond the law to the extent prescribed by law, and the problems arising in his mind to be solved will be determined by the intensity to which he gives himself over to the task of assuring safety and the clearness with which he sees the things to be accomplished.

A mine may be in such a condition from poor ventilation, bad drainage, faulty timbering or an inadequate supply of working materials that under certain conditions would warrant that operations shall cease until the defects are remedied. He realizes in closing down this mine that practically all the employes will be thrown idle and in all likelihood there will be little opportunity for them to secure other employment with the result that the consequent suffering will bear heavily on their families, also the financial structure of the company may be in such a condition that they are unable to carry on a defined program for betterments. What shall he do? Close down the mine or allow it to operate by spreading over a period of time the improvements that are necessary. It may be this particular mine is generating gas and is of a dry and dusty nature. The coal dust may not be treated or if treatment is applied it may have been done in a very negligent or incomplete manner, then, indeed, the problem does begin to carry weight, against the picture of unemployment and bankruptcy he can visualize a catastrophe with all the horror that attends such occasions.

THE human element of the mine, both in regard to the management and the employes, is another problem with which the inspector has to deal constantly.

Foremen should be selected not only because of their knowledge of mining and the mining law but also their strong, upright, law abiding characters—they should be examples of truth, honesty, courage and diligence. These characteristics to be so marked in their lives that the employes will become impressed and influenced by them.

The foreman must not only be an outstanding man morally, but a man who knows mining and has executive ability. How is the work of a mine inspector related to this subject of foremanship?

This year, 1,468 men submitted themselves to be examined by the state mine inspectors and their boards for mine foremen's and assistant mine foremen's and fire bosses certificates. Of this number 923 were successful.

The state mine inspector can, and should by exercising his rights under the law on this board, see that the mines are supervised by the type of men who will be helpful to the industry as a whole. To possess a foreman's or assistant foreman's certificate now is not a legal requirement, but you can find few if any who do not possess them as the coal companies are showing a fine spirit and a proper conception of this work by employing no one who has not given ample evidence before one of these examining boards that he has the necessary legal qualifications.

On account of his acquaintanceship and the fact that he is the dominating member of the board that recommends the granting of certificates of competency to applicants that sit for examination as mine foreman, assistant mine foreman and fire boss, he is constantly being asked by the operator to recommend men for official positions in connection with the mine, and also by the men to recommend them to the operator for any positions that may be vacant. A person so recommended may be a failure in one organization, yet make a success with another. Working conditions, temperament of supervisors, living quarters, wages, and various other matters enter into the question of whether the connection will be satisfactory to all parties concerned. It is a problem with the inspector to reconcile these different factors. Also, a careless, penurious and arbitrary attitude on the part of the management coupled with a careless, resentful and stubborn spirit on the part of the employes cause many problems to arise to which the inspector must give attention.

* Secretary of Mines, Commonwealth of Pennsylvania, Harrisburg, Pa.

Presented to 19th Annual Safety Congress, National Safety Council, Pittsburgh, Pa., October 3, 1930.

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How long and how far shall the inspector carry the responsibility of a mine while necessary recommendations that he has submitted are being carried out?

How long shall he continue to allow workmen who are careless and indifferent to the mining law to continue their vocations in the mines?

How far shall he insist on capital expenditures for necessary betterments?

How long shall he tolerate a management that has shown it is utterly incompetent to operate a mine?

Shall he insist on jail sentences or be satisfied with a nominal fine and reprimand for law violations that fortunately cause no injury?

Shall he insist on punishment to persons who are injured through violating the law? These are but some of the problems that are constantly confronting the inspector.

ANOTHER problem that vitally affects the inspector personally is his conduct in matters affecting rescue and recovery operations after a mine fire or an explosion. His responsibility here is very great indeed, for custom has set forth that he shall be in complete charge of these operations. The procedure must be very carefully planned and carried out. Subordinates and assistants must be chosen with extreme care. Orders must be precise and clearly given. There must be no doubt or question in this respect. Decisions must be made without delay and in every case must be sound for any indecision or delay might lead to immediate loss of life either on the part of those entombed or, to those who are engaged in the rescue work, or both. His problems in an affair of this kind are many and are very burdensome.

That the responsibilities and problems with which the inspector is constantly confronted have some effect on his mental and physical being is borne out by the fact that the score of inspectors who have passed away during the last three decades, they, with very few exceptions, have died suddenly, without any protracted illness.

PROBLEMS OF MINE INSPECTOR

(*From page* 914)

Adequate ventilation distributed to the various mine sections and into the working faces is primarily, of course, the solution of the gas problem, and the more frequently we have assurances of such condition through our examinations, the more assured we feel regarding the welfare of the workmen therein. Frequent air readings and analyses of the mine atmosphere go a long ways toward giving this assurance. I venture the opinion that if the state laws required larger inspection forces, mine accidents of all kinds would decrease in proportion.

In the year 1927 there were in use in Alabama coal mines approximately 3,000 electric cap lamps. At this time we have 9,135 of these lamps in use. We believe this great increase has played its part in keeping down the number of casualties from gas and other causes.

Attention is called to the number of gas casualties which took place both before and after the program as outlined above was put in effect.

Year	Fatalities	Tons mined	Tons per fatality
1924	3	19,515,935	6,538,644
1925	66	20,408,656	309,222
1926	45	21,508,812	477,973
1927	3	20,190,926	6,730,309
1928	0	18,056,116	Infinite
1929	12	18,415,914	1,534,659

UNDERGROUND transportation of coal presents a problem in safety difficult to combat. The electric locomotive, now in almost universal use, in hauling long trips at high speed, presents a hazard which did not exist in former days. Strict rules and regulations, with necessary discipline, must govern this feature of mining if casualties are to be further reduced. Practices, such as pushing trips, back poling, flying switches, coupling cars while in motion, jumping on and off moving cars, and many others, must be stopped, otherwise injury is sure to result. Ample clearance must be provided overhead as well as between the road and the ribs. Shelter holes sufficiently close to each other should be provided, and at convenient points so that men, when traveling the haulage roads, may easily and quickly find safety from passing trips. It is obvious that the responsibility of haulage safety depends to a great extent on the employe himself. Strict supervision and rigid discipline on the part of the underground officials are also very necessary.

During the past 20 years electricity has taken a firm foothold in mine operations in Alabama, and due to the numerous thin seams, the ever-present and daily hazard is great. Much of our trolley wire is unguarded. When electrification of Alabama mines began 250 volts was not considered a particular hazard. As a result of this, many miles of unshielded trolley wire extend through our mines. To require shielding of this wire now would entail much expense, and without laws would be difficult to accomplish. In some of our newer mines, however, trolley wire shielding is practiced, where the suspended wire is less than 6 feet above the rail. In the older mines we have been able to secure shielding of trolley wire at crossings, sidetracks, and at other points where men pass under in going to and from their work. Contrary to the former belief regarding the hazard of 250 volts, practically all of our electrocutions occur from some portion of the body making contact with the trolley wire carrying that voltage.

Early in this year an investigation was made for the purpose of selecting the best insulated shoe for underground workers. Samples were submitted by various manufacturers, and selections made. Many stores at the mines now carry this shoe in stock, and we are urging their use by the underground men. A similar investigation was made for the selection of an insulated cap.

FOR the purpose of presenting the manner in which mine accidents occur in Alabama, in a form easily understood by all classes of mine workers, an additional man who is a practical mining engineer was placed in the chief inspector's office in May of this year. His duties are confined largely to the investigation of accidents, going into details, and endeavoring as far as possible to place the responsibility where it belongs. Free-hand perspective sketches are drawn, which portray the accident just as it took place, and these are sent out in the form of bulletins to all the mines. If the accident was occasioned by a fall of roof, the position of the rock is shown prior to and after the occurrence. The positions of nearby timbers are shown, and the distances they are spaced apart are indicated. If the accident has resulted in electrocution, the wire or other equipment causing the fatality is shown. The details are likewise shown for any other character of accident. The causes leading up to each particular accident are shown, and warnings are given against a repetition of other accidents of a similar nature.

The sketches are distributed by the hundreds, and through the active cooperation of the mine managements find a conspicuous place on the mine bulletin board. While this practice has extended over only a short period, we feel that the display of the easily understood sketches proved to be a reminder to the individual who may be working under similar circumstances to those where the accident took place. If these sketches continue to be given the careful study and attention they warrant, we hope for further reductions of accidents.

In closing I would feel that an injustice had been done if acknowledgement were not made of the cooperation and assistance of the Alabama Mining Institute, the Holmes Safety Association, and the United States Bureau of Mines with the Alabama State Department in its daily problems.

The Use and Value of AIR ANALYSES In Illinois Mines*

By A. U. MILLER†

VENTILATION is one of the most important factors in mining, although until recent years less thought has probably been given to effective ventilation than to any other one phase of mining. In the past, very little, if any, attention was given air courses until they became so constricted by falls that the volume of air was greatly reduced; and, in addition, the stoppings and doors were so poorly constructed that only a very small percentage of air reached the face workings.

As a matter of fact, mines have been visited where the volume of air being circulated in certain sections was much larger than in others, and where the management was striving to increase the flow of air in those sections with the least air current, believing the ventilation to be deficient. After sampling and analyzing the return air from the various sections in such mines it has been found that the quality of the air in certain places with the largest flow was more impure than in some of those with the least flow.

In past years, practically all mine fans were operated by steam-driven engines supplied with steam from the mine boiler plant. No check was made on the steam consumption or the power cost of operating the fan, therefore the management had very little if any definite information as to cost of ventilating the mine.

With the increased use of electrically-driven equipment in mines electricity is being used more and more to drive mine ventilating fans, and since in many instances the current is purchased from central power plants operators have come to realize that in many cases the cost of operating the fans is very high. Some engineers estimate that it ranges from 20 to 50 percent of the total power cost of the mine. This information, together with the fact that mines are now being developed on a larger scale, requiring larger quantities of air for the men and to dilute the gases liberated, has caused the large progressive companies to make a more comprehensive study of mine ventilation, resulting in a decided improvement in the quality and quantity of air at the face workings, as well as reducing materially the ventilating costs.

A sufficient volume of pure air to dilute and render harmless any irrespirable or inflammable gases, and also to supply the underground worker with air of an oxygen content as nearly normal as possible, is an excellent investment and one upon which the efficiency of any mine depends.

Composition of Air

Quoting from page 2, Miners' Circular 33, U. S. Bureau of Mines, "According to Rosenau[1], pure, dry air at sea level contains the following gases: Oxygen (O_2), 20.94 percent; nitrogen (N_2), 78.09 percent; carbon dioxide (CO_2), 0.03 percent; and argon (A), 0.94 percent by volume. Traces of helium (He), neon (Ne), krypton (Kr), xenon (Xe), hydrogen (H_2), hydrogen peroxide (H_2O_2), ammonia (NH_3), and ozone (O_3) are also present, but as these are inert gases, they are usually included with nitrogen."

Intake and Return Air

The Mine Safety Board of the U. S. Bureau of Mines, Department of Commerce, recommends (Decision No. 8) that in coal-mine ventilation the following definitions be used:

(1) The term "intake air" and the term "return air" without qualifying adjectives shall be used only to define mechanical movement of the air respectively in an inward or outward direction with reference to the mine as a whole or to any one group of workings.

(2) When health and safety are concerned, the term "pure intake air" shall mean:

(a) Air which has not passed through or by any active workings, and (or)

(b) Air which has not passed through or by any inactive workings, unless these are effectively sealed, and

(c) Air which is free from poisonous gas and by analysis contains not less than 20 percent oxygen (dry basis) and not over 0.05 percent of inflammable gas.

Quantity and Quality of Mine Air

Relating to the quantity and quality of air to be furnished in ventilating coal mines this board recommends (Decision No. 9).

(1) The quantity in cubic feet of pure intake air flowing per minute in any ventilating split shall be at least equal to 100 times the number of men in that split.

(2) The quantity of air entering each unsealed place shall be at least 200 cubic feet per minute and as much more as may be necessary to properly dilute and carry away inflammable or harmful gases which may be present.

(3) The air shall be made to circulate continuously to the face in every unsealed place into which an appreciable amount of methane enters.

(4) The air in any unsealed place shall be considered unfit for men if it shall be found to contain less than 19 percent oxygen (dry basis), more than 1 percent of carbon dioxide or a harmful amount of poisonous gas.

Ventilation and Sealing

Relating to sealing all parts of a coal mine which can not be well ventilated and inspected (Decision No. 6):

In the interest of safety, the Bureau of Mines, Department of Commerce, recommends that in coal mines all entries, rooms, panels, or sections that can not be kept well ventilated throughout or can not be inspected regularly and thoroughly, or that are not being used for coursing the air, travel, haulage, or the extraction of coal, be sealed by strong fireproof stoppings.

Determination of Quality of Mine Air

The best method for determining the quality of air in a mine is air analysis. The U. S. Bureau of Mines has made this a part of its investigative work since the bureau was founded. According to the report of Scott Turner, director, U. S. Bureau of Mines, for the fiscal year July 1, 1928, to June 30, 1929, approximately 2,400 air samples were analyzed at the Bureau of Mines Laboratory, Pittsburgh, Pa. In addition to this number, many samples were analyzed at the field stations and on mine rescue cars. The analyses of these samples have given the mining industry some very valuable information that could not have been obtained otherwise.

* Reprinted from U. S. Bureau of Mines Report of Investigation 3043.

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[1] Rosenau, M. J., Preventive Medicine and Hygiene: 3d ed., 1920, p. 662.

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Until recently few, if any, of those in charge of mines, considered air analysis of value. However, some of those in charge of mines now realize the value of air analysis and make it a regular part of the safety work in their mines.

In Illinois the use of air analyses has made commendable progress. In connection with the investigative work of the U. S. Bureau of Mines many coal companies have requested the bureau to collect and analyze samples of the return air in their mines. In addition to the work of the bureau some of the companies have apparatus of their own for air analyses but also request the bureau to collect and analyze air samples as a check on their work.

Oxygen

Oxygen is the most important of all gases to man, because it is necessary to support life and combustion. Men work best when the air contains the amount found in pure air, which is about 21 percent. Therefore, those in charge of mines should aim to maintain the ventilating system in such a manner that the oxygen content in the mine air should be as nearly as possible that of pure air. However, men can live and work in an atmosphere where the oxygen content is much less than 21 per cent. The writer has worked in mines where it was difficult to keep the old oil-flame lamp burning and in some places where the carbide light would hardly burn. (Oil flame is extinguished at about 16.5 percent oxygen and the carbide light at about 13 percent.) Men breathing an atmosphere containing 17 percent of oxygen will breathe faster and deeper; and when breathing air containing about 15 percent of oxygen they usually become dizzy, notice a buzzing in the ears, have a rapid heart beat, and often suffer from headache. It can be seen readily from the above that to get efficiency from underground workers, they must be supplied with air containing a sufficient amount of oxygen.

Ventilation and Accidents

The writer believes that poor ventilation is a contributing factor to high accident rates. He knows from experience that while working in places where the ventilation was poor his physical and mental condition was such that he became more or less indifferent and careless and did not take any particular interest in the work to be done; as a result he was inefficient and did not do any more than was absolutely necessary to complete the day's work. Judging from statements made by other miners working where the ventilation was poor their experience was similar to that of the writer.

Formerly all coal was loaded by hand, and if a miner failed to be efficient due to poor ventilation it was his loss as well as the company's. The present trend is toward mechanization, which is chiefly on a day-wage scale, and if the miner fails to be efficient due to poor ventilation the company has to bear the entire loss. Therefore, to get efficiency with mechanization it will be necessary to supply the underground worker with an ample supply of pure air.

Typical Mine-Air Analyses

Table 1 shows the value of air analyses in a mine which had poor ventilation. These samples were collected at the request of a superintendent, because complaints had been made of "bad air" in two particular sections.

TABLE 1—ANALYSES OF "BAD AIR"

Sample No.	CO_2	O_2	CO	CH_4	N_2
1	0.77	18.00	0.00	0.12	80.16
2	.66	17.90	.00	.15	81.29

The analyses in Table 1 show that the oxygen content is entirely too low, and as a result of the information obtained from the above analyses the superintendent took steps immediately to improve the ventilation in these two sections. The Bureau of Mines has made analyses of many air samples collected in different mining States, which showed an oxygen content as low (and in some cases lower) as those in the table.

That it is possible to maintain in a mine an oxygen content nearly equal to normal outside air is shown by the following tables of analyses of air samples collected in the return air of some Illinois mines. These mines are considered gassy and are among some of the largest producers in the State.

TABLE 2—AIR ANALYSES IN AN ILLINOIS MINE

Sample No.	CO_2	O_2	CO	CH_4	N_2
1	0.21	20.24	0.00	0.11	79.44
2	.19	20.39	.00	.11	79.31
3	.20	20.38	.00	.22	79.20
4	.17	20.36	.00	.27	79.20
5	.18	20.37	.00	.20	79.25
6	.14	20.54	.00	.10	79.22
7	.13	20.84	.00	.20	79.39
8	.14	20.52	.00	.20	79.14
9	.11	20.59	.00	.52	79.78
10	.11	20.73	.00	.16	79.00

Table 2 shows that the oxygen content in the returns of this mine ranges from 20.24 to 20.84 percent and averages 20.49 percent. The methane ranges from 0.11 to 0.52 percent and averages 0.21 percent, and the carbon dioxide varies from 0.11 to 0.21 percent an average of 0.16 percent.

TABLE 3—ILLINOIS MINE-AIR ANALYSES

Sample No.	CO_2	O_2	CO	CH_4	N_2
1	0.10	20.80	0.00	0.34	78.72
2	.11	20.66	.00	.56	78.67
3	.13	20.55	.00	.33	78.99
4	.16	20.59	.00	.38	78.87
5	.16	20.56	.00	.37	78.91
6	.12	20.60	.00	.38	78.90
7	.11	20.76	.00	.44	78.69
8	.11	20.63	.00	.23	79.03
9	.12	20.59	.00	.33	78.96
10	.08	20.63	.00	.31	78.96
11	.13	20.55	.00	.33	78.99

Table 3 shows that the oxygen content in the returns of this mine ranges from 20.55 to 20.80 and averages 20.63 percent. The methane content ranges from 0.31 to 0.56 percent and averages about 0.37 percent. The carbon dioxide content averages 0.12 percent.

TABLE 4—AIR ANALYSIS IN AN ILLINOIS MINE

Sample No.	CO_2	O_2	CO	CH_4	N_2
1	0.15	20.57	0.00	0.52	78.76
2	.19	20.54	.00	.44	78.83
3	.19	20.43	.00	.55	78.83
4	.24	20.19	.00	.56	79.02

Table 4 shows that the oxygen content in the returns of this mine ranges from 20.19 to 20.57 and averages 20.43 percent. The methane content ranges from 0.44 to 0.56 percent and averages 0.52 percent, and the average carbon dioxide content is 0.19 percent.

TABLE 5—AIR ANALYSES IN AN ILLINOIS MINE

Sample No.	CO_2	O_2	CO	CH_4	N_2
1	0.15	20.45	0.00	0.41	78.99
2	.07	20.75	.00	.13	79.05
3	.22	20.55	.00	.17	79.06
4	.19	20.36	.00	.26	79.19
5	.13	20.39	.00	.54	78.94
6	.10	20.36	.00	.40	79.14
7	.17	20.31	.00	.45	79.07

Table 5 shows that the oxygen content in the returns of this mine ranges from 20.31 to 20.75 and averages 20.49 percent. The methane content ranges from 0.13 to 0.54 percent and averages 0.33 percent; the average carbon dioxide content is 0.15 percent.

TABLE 6—AIR ANALYSES IN AN ILLINOIS MINE

Sample No.	CO_2	O_2	CO	CH_4	N_2
1	0.11	20.63	0.00	0.17	79.07
2	.11	20.70	.00	.15	79.04
3	.14	20.42	.00	.61	78.83
4	.08	20.78	.00	.10	79.04
5	.08	20.69	.00	.16	79.07
6	.09	20.70	.00	.20	79.01
7	.10	20.71	.00	.40	78.79
8	.05	20.85	.00	.11	78.99
9	.05	20.77	.00	.16	79.02
10	.06	20.76	.00	.18	79.00
11	.10	20.58	.00	.27	79.05
12	.05	20.88	.00	.12	78.95

Table 6 shows that the oxygen content in the returns of this mine ranges from 20.42 to 20.88 percent and averages 20.70 plus percent. The methane content ranges from 0.11 to 0.61 percent and averages about 0.22 percent; the carbon dioxide averages 0.09 percent.

The foregoing five tables, Nos. 2, 3, 4, 5, 6, show that the oxygen content in the returns of the five mines averages 20.57 percent, the methane content averages 0.30 percent, and the carbon dioxide averages 0.15 percent. In addition to the above mines the analyses of samples collected in many other mines in Illinois can be cited where the oxygen content is similar to that shown in Tables 2 to 6.

Not only is it true that mines in Illinois can be properly ventilated, with the oxygen content maintained near that of pure air and the methane content kept reasonably low, but the same is true in other States. According to W. P. Yant and L. B. Berger, chemists, U. S. Bureau of Mines, air from the return of 275 bituminous coal mines was found to have the following average constituents: Carbon dioxide, 0.17 percent; oxygen, 20.53 percent; methane, 0.18 percent; and nitro-

gen, 79.12 percent. (See page 3, Miners' Circular 33, by J. J. Forbes and G. W. Grove, published by the U. S. Bureau of Mines.)

Regardless of the source of ignition it is necessary to have the proper "setting" before it is possible to have a gas explosion, and generally this "setting" is due to defective ventilation. If the management of some of the largest producing mines can maintain the ventilating systems in such a condition that nearly pure air is supplied the face workings and in such a volume that the methane content is kept at a low percentage, then it is reasonable to suppose that it can be done in all mines; and if this is done, and if extra precautions are taken to guard against any unusual conditions that may arise, gas explosions will be practically eliminated, the efficiency of the operation increased, and reduction of accidents encouraged.

The foregoing tables also show that air analyses are valuable in determining the percentage of methane liberated in a mine. Methane, because of its explosibility when mixed with air and because of the quantities in which it is found in coal mines, is considered the most dangerous gas; it is therefore very essential to know whether or not a mine is liberating this gas.

Definition of Gassy Mines

With the development of deeper coal beds that liberate considerable methane, there has been more or less discussion as to when a mine should be considered gassy. Some mining men do not consider a mine gassy unless a large volume of methane can be detected with a flame safety lamp. They also state that there is no hazard in connection with a "little gas." Others are of the opinion that a mine should be considered gassy when the smallest quantities are detected.

The U. S. Bureau of Mines believes that all coal mines are potentially gassy; but for the purposes of administration in respect to prevention of explosions and fires, the bureau recommends the following classification (Decision No. 3):

Class 1 Coal Mine: A practically nongassy mine in which inflammable gas in excess of 0.05 percent can not be found by systematic search.

Class 2 Coal Mine: A slightly gassy mine in which (a) inflammable gas has been found[2]—but in amount less than 2 percent in still air in any active or unsealed-abandoned workings; or

(b) inflammable gas can be found, but in amount less than 4 percent, in some place from which the ventilating current has been shut off for a period of one hour; or

(c) inflammable gas can be found[3] but in amount less than ¼ percent, in a split[4] of the ventilating current; or

(d) inflammable gas enters a split of ventilating current at a rate[5] of not more than 25 cubic feet per minute.

Class 3 Coal Mine: A gassy mine in which inflammable gas is found in amount greater than specified for a Class 2 coal mine.

The Mine Safety Board (Decision No. 9) U. S. Bureau of Mines, Department of Commerce, also makes the following recommendations pertaining to gassy mines:

If the air in any unsealed place, when sampled or tested in any part of that place not nearer than 4 ft. from the face and 10 in. from the roof, shall be found to contain:

(a) More than 1½ percent of inflammable gas, the place shall be considered to be in a hazardous condition and require improved ventilation, and

(b) If more than 2½ percent of inflammable gas is found, the place shall be considered dangerous, and only men who have been officially designated to improve the ventilation and are properly protected shall remain in or enter said place.

If the air in the split which ventilates any group of workings contains more than 1½ percent of inflammable gas these workings shall be considered to be in a dangerous condition and only men who have been officially designated to improve the ventilation and are properly protected shall remain in or enter said workings.

Air Samples From "Nongassy" Mines

It is believed that Table 7 shows that the Mine Safety Board of the U. S. Bureau of Mines is justified in its statement that all mines are potentially gassy. These samples were collected in a supposedly nongassy mine and the analysis of the return air shows that the mine is liberating but a very small volume of this gas; however, there was a gas explosion in the mine in which several men were killed.

TABLE 7—ANALYSES OF AIR FROM A SO-CALLED NONGASSY MINE

Sample No.	CO_2	O_2	CO	CH_4	N_2
1	0.04	20.92	0.00	0.00	79.04
2	.05	20.87	.00	.05	79.05
3	.05	20.57	.00	.03	79.35
4	.04	20.79	.00	.03	79.14
5	.09	20.62	.00	.04	79.25
6	.12	20.80	.00	.03	79.05

Table 7 shows that the oxygen content in this mine ranges from 20.57 to 20.92 and that the average is 20.76 percent. The methane ranges from 0.00 to 0.05 percent. These analyses indicate that the air in this mine was very nearly that of the outside atmosphere.

Sample 1, Table 7, was taken on the main intake after the air had traveled about 1½ miles from the shaft bottom and shows 20.92 percent of oxygen and the absence of methane. Sample 2, showing 0.05 percent methane, was taken at the face of a cross entry that was in about 250 ft. with a cross cut, about 30 ft. from the face, that was turned off the intake air course about 10 ft. inby where sample 1 was taken. Sample 3 was taken 500 ft. and sample 4 about 750 ft. outby the point where sample 1 was taken; these samples were taken in the return from separate splits and show only 0.03 percent of methane. Samples 5 and 6 were taken on the main returns near the shaft bottom and show only 0.04 and 0.03 percent of methane, respectively, with a total volume of air in the two returns of approximately 56,000 cubic feet per minute. Notwithstanding the small volume of methane liberated in this mine, as shown by the air analyses, 1,200 feet inby the point where sample 1 was collected, methane that accumulated in the face of an entry was ignited by an open light, resulting in a gas explosion that killed several men.

The Bureau of Mines also has a record of a western mine in which air analyses showed the total absence of methane in the return air over an extended period, yet, one morning the management found between shifts that a large quantity of methane had suddenly been liberated. This volume of gas might have caused a disastrous explosion if the management had not been on the alert. It is therefore believed that in the interest of safety, all coal mines should be considered gassy, and precautions should be taken to guard against the accumulation and ignition of methane.

Some mine superintendents are of the opinion that the mines under their supervision are nongassy, doubtless due to the fact that the mines are relatively well ventilated and that no gas has been detected in them with a flame safety lamp. However, air analyses often prove that such is not the case and that some of the supposedly nongassy mines are really liberating more methane each 24 hours than some considered gassy and in which there have been disastrous gas explosions.

Table 8 shows the analyses of samples collected in the return air of a mine which the superintendent considered nongassy and absolutely safe as far as a gas hazard was concerned.

TABLE 8—AIR ANALYSES FROM A "NONGASSY" MINE

Sample No.	CO_2	O_2	CO	CH_4	N_2	Vol. of air cu. ft. per min.
1	0.26	20.21	0.00	0.14	79.39	27,075
2	.23	20.30	.00	.12	79.35	44,625
3	.23	20.25	.00	.13	79.39	84,700

Table 9 gives the approximate volume of CH_4 being liberated in the return air every hour and every 24 hours, and the approximate volume of an explosive mixture of methane and air the volumes of methane would make.[6]

[2] By employing an approved flame safety lamp, with flame drawn low, or by employing an approved gas detector, or by sampling and analysis with an approved gas analytical apparatus.

[3] By sampling and analysis with an approved gas analytical apparatus or by employing an approved gas detector.

[4] If but one continuous ventilating current is employed in a mine, this shall be considered a "split" for the purpose of this definition.

[5] Determined by sampling, analysis, and ventilating-current measurement.

[6] Based on 9.5 percent methane.

TABLE 9—AIR-METHANE MIXTURES

Sample No.	%CH_4	Cu. ft. air per min.	Cu. ft. CH_4 per min.	Cu. ft. CH_4 per hour	Cu. ft. CH_4 per 24 hrs.	Cu. ft. approx. vol. explo. mixt. methane & air-24 hr. vol. methane would make at most violent explosive point.*
1	0.14	27,075	37.9	2,274	54,476	573,431
2	.12	44,625	53.5	3,210	77,040	810,947
3	.13	84,700	110.0	6,600	158,400	1,667,473
Total		156,400	201.4	12,084	289,916	3,051,851

* See Note 6.

Table 8 shows that the methane content in the return air of this mine ranges from 0.12 to 0.14 percent, which is low as far as the percentage is concerned. However, by referring to Table 9, it is found that when the volume of air is considered and the methane calculated on an hourly, or 24-hour, basis, one split is liberating approximately 6,600 cu. ft. of methane an hour and approximately 158,000 cu. ft. each 24 hours. Table 9 also shows that the mine as a whole is liberating 12,084 cu. ft. of methane each hour and 289,916 cu. ft. each 24 hours. The volume of methane liberated in this mine each 24 hours would make a volume of an explosive mixture of methane and air, at its most violently explosive point, of approximately 3,051,851 cu. ft. (Based on 9.5 percent methane.) Probably a better conception of what the gas hazard is in this mine may be had when we consider the fact that the U. S. Bureau of Mines has found that 200 cu. ft. of a mixture of methane and air has initiated violent coal-dust explosions.

When the superintendent of the mine where the samples were taken that are listed in Table 8 saw the results of the analysis as listed in Table 9 he stated that he would not have believed it if he had received the information from any other source and except by air analyses, and that he could now see why there were explosions in so-called nongassy mines. He also stated that as a result of the information obtained by the air analyses he would give the gas hazard in this mine due consideration.

Air Deficient in Oxygen

A sample of air was collected in a mine outby a sealed area that had been under seal for some time. The seals had been placed on the main entries about 1,600 ft. inby the bottom of the shaft and about 600 ft. inby a motor barn in which men were working, making repairs to electrical equipment, etc. Ventilation on the main entries extended only as far as the motor barn, about 600 ft. outby the seals.

While an investigator was enroute to the seal to collect air samples from the sealed area a flame safety lamp was extinguished about 200 ft. inby the motor barn. No further attempt was made to reach the seal, but instead an air sample was collected where the safety lamp was extinguished. The analysis was found to be: Carbon dioxide, 1.59 percent; oxygen, 15.49 percent; methane, 2.31 percent; and nitrogen, 80.61 percent.

Ordinarily, mining men believe that there can be no explosion hazard in an atmosphere that will extinguish a flame safety lamp. It is true that methane could not be ignited by an open light in a mixture that will extinguish it. However, since it requires less than 12.1 percent of oxygen to prevent the ignition of methane it is possible to have an ignition from some other source, such as an electric arc. The percentage of methane shown in the analysis is not within the explosive range, yet it is too high for safety.

After receiving this analysis the management of the mine required all employes working in the motor barn and around the shaft bottom to use closed lights and also increased the ventilation at the seals.

Tables 10 and 11 show the analyses of air samples collected by Bureau of Mines engineers, and while they were not collected in Illinois mines they contain some very interesting information.

TABLE 10—ANALYSES OF AIR LOW IN OXYGEN AND HIGH IN METHANE

Sample No.	CO_2	O_2	CO	CH_4	N_2
1	0.8	15.6	0.00	7.1	76.5
2	.5	16.1	.00	6.4	77.0

Tests were made for methane with a flame safety lamp before the samples were collected, but no cap was detected on the lamp. It will be observed that the oxygen content as shown by the analyses is below that at which a flame safety lamp is extinguished; however, the lamp burned in this mixture. When a flame safety lamp continues to burn without indicating a noticeable gas cap it is generally presumed that the percentage of gas is very small, if any, and there could be no explosion hazard in an atmosphere of this kind. Quoting G. W. Jones, U. S. Bureau of Mines, Pittsburgh, Pa., "The above mixture is inflammable and the reason the safety lamp continued to burn was due to the mixture feeding the flame. Had no methane been present the safety lamp would have been extinguished. The above analyses indicate a dangerous mixture that could cause an explosion and yet would not be detected other than by air analyses.

The analyses in Table 11 are of samples collected by engineers of the U. S. Bureau of Mines. Previous to taking the samples, a careful test was made for methane with a flame safety lamp, but none could be detected.

TABLE 11—ANALYSES OF OXYGEN-DEFICIENT AIR

Sample No.	CO_2	O_2	CO	CH_4	N_2
1	0.54	18.43	0.00	1.22	79.81
2	.53	18.27	.00	1.79	79.41

The analyses show a methane content of 1.22 and 1.79 percent and while a test was made for methane no cap could be discerned in the lamp, doubtless due to the low oxygen content—18.27 to 18.43 percent.

Mine Fires and Air Sampling

At the request of a mine superintendent Bureau of Mines engineers collected air samples in the returns of a large producing mine. When these samples were analyzed, the analyses of one sample showed the following: Carbon dioxide, 1.72 percent; oxygen, 18.08 percent; carbon monoxide, 0.01 percent; methane, 0.25 percent; and nitrogen, 79.94 percent.

These samples show a high carbon dioxide content, low oxygen, and 0.01 percent of carbon monoxide, which is very unusual in supposedly normal mine air. It so happened that the return where this sample was collected included the return from some abandoned workings which the company intended to seal at some future time; however, when the superintendent received the analysis of this sample, he made an investigation of the old workings, found indications of a gob fire, and sealed the area immediately.

If ever there was a time and place when the adage "an ounce of prevention is worth a pound of cure," is applicable it is in connection with mine fires. Fires have always been a serious problem in coal and metal mining and have caused some of the most serious mine disasters in the United States, therefore one of the most important duties of those in charge of mines is to eliminate, as far as possible, the causes that are responsible for them. Some of the principal causes of mine fires are as follows: Blasting, particularly when black powder is used; gas and coal dust ignitions or explosions; defective wiring and electrical equipment; spontaneous combustion; open lights; and incendiarism.

An important procedure the management should follow is to establish a fire-fighting organization and obtain ample fire-fighting equipment, so that if a fire does occur it can be extinguished as soon as possible. Engineers of the U. S. Bureau of Mines have investigated serious mine fires, which they believe could have been extinguished in their incipiency, without loss of life or much property, had there been a few fire extinguishers available at the proper time.

Until recent years very little, if any, consideration was given to maintenance of fire protection in and around mines. However, at present most mining companies have at least some fire-fighting equipment, and some of the larger com-

panies maintain fire-fighting equipment, and an organization both on the surface and underground; in many instances a single fire has justified the cost of the installation and organization.

Fire-fighting organizations and equipment are established and maintained to protect property in the cities, and if this is necessary and good business it is at least equally important to have fire protection in and around mines. Fires in the city can usually be fought from any angle, but underground they can only be attacked as conditions will permit and often present a very difficult problem, particularly if there is a large number of men in the section of the mine and all avenues of escape are cut off.

Fighting Mine Fires

No set rule can be given for fighting mine fires, as each fire represents a problem within itself and the procedure must be governed by existing conditions. However, it can be stated that two of the most essential factors are a good organization and adequate fire-fighting equipment. Usually if conditions are such that the fire can be fought directly, water, fire extinguishers, sand, or rock-dust, is used. Many mine fires get beyond control, making it impossible to extinguish them by direct means; consequently, it is necessary to seal the area and extinguish the fire through lack of oxygen to support combustion.

Unsealing Mine-Fire Areas

After a fire area is sealed, it then becomes a problem to determine when and how to unseal the area, and if an error is made in opening the area the hazard is greatly increased. Generally the fire area remains sealed a month or longer or until those in charge believe that the fire is out. Sometimes when the area is opened it is found that the fire is extinguished, while in other instances the reverse is true, and it is necessary to reseal. When such is the case the loss often is greater than if the area had been left sealed for a longer period.

In most cases the premature opening of a sealed fire area is due to the desire to start production in the sealed area or to lack of information pertaining to conditions behind the seals. The writer believes that anything to be gained by being hasty in opening a fire area is liable to be overcome by the additional hazard and by the possibility of an explosion during resealing.

Air Sampling in Opening Fire Areas

One of the best methods of determining the conditions behind a sealed area and one that gives some of the most valuable information is air analysis. Before an attempt is made to unseal a fire area the oxygen content should be low enough to prevent the possible ignition of explosive gases. In their experiments with methane and air mixtures G. W. Jones and G. St. J. Perrott of the U. S. Bureau of Mines found that when the oxygen content was reduced below 12.1 percent it was impossible to have an explosion, regardless of the proportion of methane present. In addition to methane the sealed area may also contain varying small percentages of hydrogen, carbon monoxide, and other combustible gases.

Following the sealing off of a fire area there should be a rapid drop in the oxygen content behind the seals, due principally to the oxygen being consumed in the combustion of the coal and absorbed by the coal. The failure of the oxygen content to drop is almost a sure indication that there are leaks into the fire area, if the sampling has been done efficiently.

There will also usually be an increase in the methane content behind the seals.

An important factor that should always be taken into consideration in connection with a sealed mine fire is the amount of carbon monoxide present behind the seals. It is believed that the fire region should remain unopened until this gas has disappeared. Some authorities claim that the presence of carbon monoxide does not always indicate that a fire is present, or that there is no fire if carbon monoxide is not found, yet it is believed that when this gas is absent and the oxygen content is 2 percent or lower the fire area can be opened with safety, provided always that the sampling has been done efficiently.

Pages 25-26, Miners' Circular 36, published by the U. S. Bureau of Mines, state:

"The unsealing of any mine fire is hazardous and should not be treated lightly by those engaged in the work. Although a sealed area containing explosive gas undoubtedly presents the most dangerous condition, all mine fires should be considered as potential hazards when the time for unsealing them arrives. Besides selecting the proper time for the unsealing, which should be carefully considered, every possible safeguard should be given those engaged in the work.

"Experience and scientific study have shown that no attempt should be made to unseal a mine fire (1) until the oxygen content of the sealed atmosphere is low enough to make explosions impossible, irrespective of the amount of combustible gases that may be present, and (2) until the carbon monoxide (CO), the indicator of combustion, has disappeared. In addition, the area under seal should be given sufficient time to cool, to minimize the chance of rekindling when air is admitted for the recovery of the affected region. In substance, some of the principal factors that govern the time for unsealing fire areas, as gained from personal experience, observation, and consultation with mining men experienced and conversant with this subject are, in brief: (1) Extent and intensity of fire at time of sealing; (2) characteristics of burning material and overlying strata; (3) tightness of seals and enclosed area; (4) influence of barometric pressure on the enclosed area; (5) locality of the fire area with respect to ventilation; (6) sampling and analysis of the atmosphere under seal; and (7) composition of fire gases in the sealed area.

"The characteristics of the burning material (that is, whether it is wood, bituminous coal, or anthracite), the rate of burning, and the change of gas composition are factors that may influence rekindling when air is again admitted. Coals that are high in volatile-combustible matter burn faster and are more likely to rekindle when air is admitted than coals or material low in volatile-combustible matter. The character of the strata overlying the coal bed plays a very important part in determining the time for unsealing. For example, an oily shale roof that has presumably covered a fire will retain heat for long periods, even after the oxygen content of the sealed area is reduced to a point where combustion is impossible. Instances are known where roof of this character was hot thirty days after the oxygen content of the fire area has been reduced below three per cent. Under these conditions the likelihood of rekindling when air is admitted is considerably augmented; furthermore, it is extremely difficult to get to the seat of the fire for long periods where the roof has caved and covered the fire and is combustible. Another striking example where caved combustible roof materials aggravate the fire under seal is where there is a coal roof or where the immediate roof over the coal is composed of alternate bands of bone, shale, and coal, some of which is fairly high in sulphur."

For further information on sealing and unsealing mine fires, mine gases, and air analyses, see Miners' Circulars 33, 34, 35, and 36, which are parts 1 to 4 of the Advanced Mine Rescue course published by the U. S. Bureau of Mines.

Examples of Value of Air Samples in Unsealing Fire Areas

Following are brief accounts of four mine fires that occurred in Illinois mines and the use and value of air analyses before unsealing them.

Mine 1: About 4:05 p. m. August 10, 1928, a fire occurred in mine 1 near the mouth of a pair of abandoned panel entries. The fire was caused by a small gas explosion which set fire to some timber cribs. The management tried to extinguish it but was unable to do so and finally sealed the region. The seals were constructed near the mouth of the cross entries off which the panel entries were turned and were completed about 9 p. m.

The first seal was temporary, and was constructed with Burkett lath nailed on props and plastered with wood fiber. The permanent seals were double and placed about 8 ft. outby the temporary ones. In constructing the permanent seals, Burkett lath was nailed on 2 by 4-in. studs, with a space of 16 in. between the two walls, the intervening space being filled with rock-dust. Burkett lath was placed on the inner and outer sides

of the outside wall and this space also filled with rock-dust. The face of the permanent seals was then plastered with wood fiber. A pipe equipped with a valve on the outside was placed in the seals, so that air samples could be collected as desired.

Table 12 shows the analyses of air samples from the sealed region and indicates that the seals were tight and effective.

TABLE 12—AIR SAMPLES FROM SEALED AREA, MINE 1

Sample No.	CO_2	O_2	CO	CH_4	N_2	Date
1....	3.1	6.8	0.12	15.1	74.88	Aug. 20, 1928
2....	2.9	6.4	.12	15.4	74.18	Aug. 21, 1928
3....	3.0	6.2	.15	16.2	74.65	Aug. 22, 1928
4....	3.1	5.3	.12	18.3	73.18	Aug. 23, 1928
5....	2.9	3.8	.04	21.7	71.56	Aug. 28, 1928
6....	2.9	2.8	.06	27.4	66.84	Sept. 4, 1928
7....	3.0	0.9	.01	33.3	62.80	Sept. 11, 1928

It will be observed in Table 12 that from the time the area was sealed to the time the first samples were collected, August 20, the oxygen content dropped from 20.55 (percent of oxygen found in area when ventilated) to 6.8 percent, or 13.75 percent in 10 days. The analyses also show the region contained 0.12 per cent of carbon monoxide at this time. From August 20 to September 11 the oxygen content dropped from 6.8 to 0.9 percent and the carbon monoxide from 0.12 to 0.01 percent. This is a drop, in 22 days, of 5.7 percent in the oxygen and 0.11 percent in the carbon monoxide. The fire territory was opened on September 15, five days after the last sample was taken. Judging by the gradual and continuous reduction of the oxygen and carbon monoxide, as shown by the analyses, it is believed when the fire region was opened, carbon monoxide was not found, and the oxygen content was even lower than that shown in the last air sample.

Mine 2: The following two fires occurred in the same mine. The first was discovered about 11 p. m. November 24, 1928, and the other about 6 p. m. January 31, 1929. Both fires were due to blasting with black powder. The management was unable to extinguish the fires, so the regions were sealed.

The seals were constructed with 1 by 12-in. boards nailed on props. They were built by nailing the first board at the top. Each succeeding board was beveled on the edge lengthwise and placed by overlapping the beveled part on the lower edge of the board above. The groove made by overlapping the beveled edge of the boards was filled with wood fiber and the face of the seals plastered with the same material. After the plaster was set the face of the seals was painted at regular intervals with a mixture of water and plaster of about the consistency of butter-milk. A pipe, equipped with a valve on the outside, was placed in the seals so that air samples could be collected when necessary.

Table 13 shows the analyses of samples collected from the sealed area. This table shows that from the time the territory was sealed until the first samples were taken, December 12, the oxygen content dropped from 20.12 to 3.3 per cent. The analyses also show that the carbon monoxide content at this time was 0.4 percent.

TABLE 13—AIR ANALYSES FROM SEALED REGION, MINE 2

CO_2	O_2	CO	CH_4	N_2	Date
6.7	3.3	0.4	15.8	73.80	Dec. 12, 1928
4.5	3.1	.12	26.3	64.58	Jan. 1, 1929
6.0	1.2	.02	32.5	60.28	Jan. 15, 1929

The analyses of the samples collected on January 5 show the oxygen content dropped from 3.3 to 3.1 percent. This is a reduction of only 0.2 percent, as compared with the samples collected December 12. After receiving these analyses the superintendent was informed that the seals were probably leaking. A thorough examination was then made and leaks found in the floor and sides of the seals. These leaks were replastered immediately.

On January 15, 1929, 10 days after the seals were repaired, another set of samples was collected. The analyses show the oxygen content dropped from 3.1 to 1.2 percent and the carbon monoxide from 0.12 to 0.02 percent. After these analyses were received the seals were inspected closely each day. On January 26 the fire region was opened, and although the fire was extinguished some of the rock was still hot when it was loaded.

Table 14 shows the analyses of air samples collected behind the second sealed fire region in Mine 2.

TABLE 14—AIR ANALYSES, SAMPLES COLLECTED BEHIND SEALED AREA, MINE 2

Sample No.	CO_2	O_2	CO	CH_4	N_2	Date
1....	6.2	2.8	0.7	20.5	70.30	Feb. 17, 1929
2....	5.6	.1	.2	37.6	59.80	Mar. 6, 1929
3....	5.8	.5	.2	38.1	55.40	Mar. 15, 1929
4....	5.2	1.0	.4	46.1	47.66	Apr. 4, 1929
5....	4.8	.2	.1	51.8	43.19	Apr. 17, 1929

It will be seen in this table that from the time the region was sealed, January 31, until the first samples were collected, February 17, the oxygen content dropped from 20.55 to 2.3 percent. The analyses also show that the carbon monoxide at this time was 0.7 percent. From February 17 to April 17, when the fire area was opened, there was a gradual and continuous drop in the oxygen and carbon monoxide content. When the area was opened the fire was extinguished and the rock cool when loaded.

By comparing the tables of air analyses of Mine 2 with that in Mine 1 it will be observed that the analyses of Mine 2 show a methane content of 32.5 and 51.8 percent in the sealed regions and that of Mine 1 shows a methane content of 32.5 percent. The percentage of methane in the first fire region in Mine 2 is equal to that of Mine 1, and the percentage of methane in the second fire region in Mine 2 is more than 20 percent higher than that in Mine 1. Mine 2 is located in what is considered a nongassy field, while Mine 1 is in what is considered the most gassy field in Illinois. This is some of the information that may be obtained by air analyses and shows what might be expected in coal mines that are supposed to be nongassy.

Mine 3: About 8 a. m. June 24, 1929, a fire was discovered in Mine 3. It is believed that the fire was due to a fall of coal dislodging a machine wire, causing a short circuit between the wire and rail, or the wire and the metal parts of a car. The management tried to locate the fire but was unable to do so and finally sealed the region. The seals were completed about 8 p. m.

The seals were constructed with Burkett lath nailed on props and plastered with wood fiber, but not well hitched into the ribs. A pipe, with a valve on the outside, was placed in the seals so that air samples could be collected when desired.

On July 26, at the request of the superintendent, the seals were examined and samples collected from the region. While the seals had been plastered the facing was very rough and doubtless leaking considerably, as the air could be heard passing back and forth through them as the trips moved on the haulage ways. The superintendent painted the seals, as was done in Mine 2.

Table 15 shows the analyses of samples from the sealed area in Mine 3.

TABLE 15—ANALYSES OF AIR SAMPLES FROM SEALED REGION, MINE 3

Sample No.	CO_2	O_2	CO	CH_4	N_2	Date
1...	5.1	8.3	0.05	5.09	81.46	July 25, 1929
2...	6.8	3.5	.01	5.09	84.70	Aug. 2, 1929
3...	4.85	7.75	.00	5.7	81.70	Sept. 5, 1929
4...	6.8	1.6	.00	9.6	82.00	Sept. 15, 1929

The analyses of the samples collected July 25, 31 days after the place was sealed, show that the oxygen content dropped from that of normal mine air to 8.3 percent. This was a very good indication that the seals were leaking up to the time the samples were taken. About 15 coats of cement and water were applied to the face of the seals after the samples were collected July 25. On August 2, another set of samples was collected. These show that the oxygen content dropped from 8.3 to 3.5 percent, indicating that the paintings of the seals was somewhat effective. The samples collected September 5 show that the oxygen content had increased from 3.5 to 7.75 per cent.

The superintendent was informed that the seals probably were again leaking, and it was suggested that they be examined thoroughly. This was done but no leaks were found. The entry ribs were sounded in proximity to the seals, and it was discovered that the coal on one of the entry (*Continued on page* 931)

A modern COAL WASHING PLANT in MISSOURI

By J. W. WILSON*

General exterior view of washery of the Central Coal & Coke Company at Keota, Mo.

EARLY in 1929, the old, basket-type jig washer of the Central Coal & Coke Company, at Keota, Mo., about 4 miles northwest of Bevier, on the Bevier & Southern Railroad, was destroyed by fire. In considering replacing this plant the coal company sent its engineers and skilled operating men to a number of late installations of coal-cleaning plants, and they made a very careful study of the various devices and processes in use in these newer plants.

Early this year, the Link-Belt Company was selected to design and install a new washery located on approximately the site of the old one, together with apparatus for the unloading of the raw coal, and the screening and loading of the various sizes of washed coal. The coal unloading device is required because the coal is loaded into solid bottom railroad gondola cars at the tipple near Bevier, and brought to the washer in these same cars, where they are unloaded.

This new Link-Belt Simon-Carves washery is equipped with the latest in mechanical coal handling, conveying, screening and transmission machinery; and the Link-Belt Simon-Carves type of coal washery and water clarification system is also complete, together with the latest in dewatering devices for the small coal and the recovery of the water.

The washery handles either 2½-in. screenings or ⅞-in. screenings from mine No. 68, at Bevier, Mo. Here solid bottom gondola coal cars are loaded at the mine tipple, and each day's run at the mine is switched over the Bevier & Southern Railroad to the load yard of the washer, about 4 miles away.

The railroad cars loaded with the raw screenings are then placed under the unloader and emptied by means of a bucket type digging elevator, which discharges into a troughed belt conveyor running on Timken-bearing equipped three-roll troughing idlers (having anti-friction bearing return idlers), which in turn discharges into a 50-ton raw coal equalizing bin ahead of the washer box.

Underneath this raw coal bin the coal is drawn out by a feeder conveyor of the flight type, and uniformly fed at the rate of 100 tons per hour to the intake side of a five-compartment Link-Belt Simon-Carves washer box for concentration. The cleaned coal is sluiced out of the outlet end of the washer box directly to a pair of flexible-hanger shaker screens for classification. When 2½-in. screenings are handled, the 2½-in. x ⅞-in. nut coal is sprayed with clean water at this end and discharged onto a loading boom, for careful loading of the nut coal into railroad cars.

The circulating water, together with the ⅞-in. screenings, are then sluiced to a pair of dewatering shakers of the jigger type, fitted with brass wedge-wire screens, the water and fine dust being gathered underneath in a sump from which a centrifugal pump discharges into the top in the center of an inverted settling cone of steel construction, where clarification of this circulating water takes place.

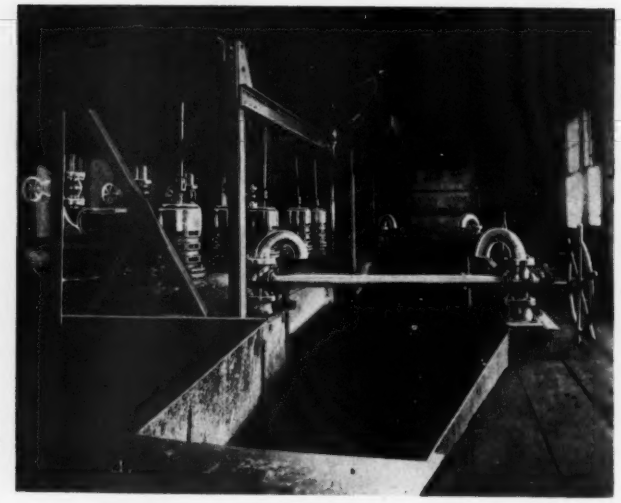
A circular steel curtain is suspended, which extends downward into the water, permitting the discharged solids in the circulating water to settle to the bottom of the cone, where this solid fine coal accumulation is constantly being drawn out by gravity, and discharged onto the jigging dewatering shakers, on top of the ⅞-in. washed screenings coming regularly from the classifying screens. This fine coal is thus recovered by the filtering of the slurry through the screenings and back into the circulating-water sump below.

From the top of the water in the cone an overflow, located outside of the curtain in the cone, takes the clarified water back to the washer box by gravity; hence all the clarification cone functions are performed without any moving machinery, gravity alone being used. The head created by the tank elevation with reference to the washer box and dewatering apparatus, permits the flow by gravity of the water and slurry from the bottom of the cone to the dewatering shakers, and clean water from the top of the cone to the washer box.

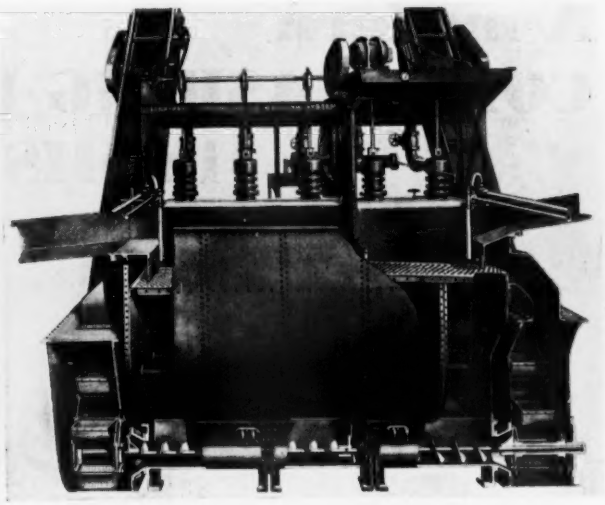
The refuse from the washer box is gathered by two small elevators built into this washer unit at each end, and discharged directly into the refuse bin, where it is drawn off at intervals by a

Another outside view of the washery

* Engineer, Link-Belt Company, Chicago, Ill.



Interior view of washery. Coal 2½" to 0" is handled at 100 T. P. H.



X-ray drawing showing arrangement of wash box

2-ton refuse car running on rails underneath, and hauled up an incline by rope hoist to the refuse dump adjoining the washer.

Fresh water is drawn by a centrifugal pump from a pond about 600 ft. from the washery, and this fresh water is pumped up into a fresh-water tank located close by the washery. From this tank a fresh-water line goes to the classifying shakers for the washed coal, where this fresh, clean water does a final spraying and rinsing of the washed coal before loading. This water also is then gathered into the circulating system and forms the make-up water.

As much of the impurity taken out is in the form of a soft fire-clay and somewhat soluble, provision is made to be able to keep the circulating water system clean by taking off an effluent of dirty water, and adding a larger quantity of fresh water in proportion to the amount of effluent drawn off.

The very excellent results obtained from this plant are particularly gratifying on account of the difficult coal to wash. Embedded in the coal veins at frequent intervals are large globules of soft fire-clay. In some sections of the seam they are as close together as 12-ft. centers, and a cubic foot or more in volume each. These gobs may be anywhere in the seam, and consequently a good many times are shattered and broken down with the coal in shooting—so much so that the screenings look more like clay than coal, when loaded at the tipple, the mine being very wet.

In the Link-Belt Simon-Carves washer box this almost soluble fire-clay is drawn off as refuse immediately, and does not contaminate the circulating water.

When the washer box will reject quickly such material, it can easily be understood why the results of washing in it are so uniform and high grade.

The washery is in charge of one operator, and one man takes care of loading the nut and slack coal, and one man attends to the refuse disposal. In the old washer it was necessary to empty the entire water system twice a day because of its contamination, once at the noon shutdown, and again at the end of the day shift. This troublesome delay is entirely done away with, and a tremendous saving in water is also effected.

MINE VENTILATION

(*From page* 913)

I would much prefer to have them well sealed, and when I say "well sealed" I mean by absolutely tight stoppings which are practically explosion proof.

A correct and up-to-date ventilation map is highly desirable. Such a map should show the direction of air travel in all entries and should clearly show the exact location of all doors, stoppings, brattice, curtains, and overcasts. Everyone who really plans a ventilation system in detail has such a map at some time, but few of them are kept up to date. If a superintendent kept a ventilation map of his mine up to date, he would never allow two different systems of ventilation cut into each other, as happens when two mines or different sections of the same mine cut into each other, because when this happens no one can tell from one day to the other how the air is traveling in certain sections. Needless to say, this is bad practice.

No discussion of ventilation would be complete without some mention of reversing the air. Many people think it is the first and best thing to do immediately after an explosion. In most mines, however, when the direction of air travel is reversed at the fan, the air is not completely reversed, but is rather short-circuited away from most of the mine. Most doors are hung to stay shut with air pressure on it holding it shut. When the air is reversed, such doors are opened and are kept open, and the air is short-circuited through these open doors. Even if you did cause complete air reversal after a mine explosion you would be changing conditions, and that is something we do not want to do after a mine explosion until we are sure of just what is going to take place with conditions changed. After a mine explosion if the fan is running keep it running; if it is stopped, leave it stopped until you have investigated and decided on the best thing to do.

To get back to dollars and cents: At 4 cents per kilowatt hour one horsepower on ventilation cost $261.60 per year. A saving of but 5 hp. at this rate means a saving of $1,308 per year. If this saving would continue for 20 years, we could afford to spend $13,000 to accomplish it, and we would realize 6 percent interest and a complete return on the capital investment.

There is nothing mysterious or difficult about mine ventilation. The operation of a centrifugal fan is directly comparable to the operation of an electric generator or a centrifugal pump and the flow of air is directly comparable to the flow of electricity or water. Resistances and pressures generated to overcome resistances are likewise comparable in all three instances. It is true that there is more lack of knowledge displayed on ventilation than on any other part of coal mining. There is no reason for this except that the study of ventilation is considered to be very difficult. This is not so; the study of ventilation is not hard and it is intensely interesting.

METALS

GUY N. BJORGE
Editor

Practical Operating Problems of the Metal Mining Industry

Long Hole Prospect Drilling

at the RAY MINES of the Nevada Consolidated Copper Co.

By Moses Brown, Jr.*

THE Ray Mines, which with the concentrating plant at Hayden constitute the Arizona Division of the Nevada Consolidated Copper Company, are situated in the Mineral Creek Mining District, Pinal County, Ariz., about 90 miles southeast of Phoenix, the state capital.

The geology of the Ray District has been quite adequately described in several reports and papers at various times, and for the purpose of this paper it is felt that a very brief review, confined entirely to the characteristics of the ore body, will suffice.

The ore body is a metamorphosed, quartz-sericite schist, mainly of secondary origin. The mineralization is a secondary concentration from primary sulphides in which pyrite predominated, and the pyrite has been replaced in varying degrees through the mineralized zone by finely disseminated chalcocite. The contact between the completely oxidized capping and the ore body is generally quite distinct, while the bottom of the ore body is limited in some places by diabase sills and in others by gradual fading out of the secondary concentration. Planes of weakness parallel to, and at right angles to the schistosity are well defined, and others, less pronounced, run in different directions. On the upper horizons the ore breaks coarsely in mining, but has a tendency to break finer with depth. Two points to bear in mind as having particular bearing on the subject covered by this paper are the finely disseminated occurrence of the ore and the fact that the rock is easy drilling. While there is every gradation of hardness, from very hard to very soft, nine-tenths of the drilling ground may be classed as medium soft.

In order that some idea may be had as to the nature of the prospect development work carried on at Ray, a short description of the original prospect work by churn drilling and method of development is necessary. As in the case of most low grade ore bodies, the first prospecting was done by churn drilling over the entire area with holes spaced on coordinated sections 200 ft. apart, and subsequent mining operations were planned from the results obtained from these churn drill holes. However, before actual mining operations could be carried on it was necessary to determine the lateral extension of the ore beyond the outlying drill holes which showed ore, and it was also found necessary to prospect areas which were influenced by faults and dykes not outlined sufficiently by the churn drilling. This prospect work was formerly done by drifting and raising, branch raises being carried out of the drifts usually to the ore limits and spaced at approximately 75 ft. intervals. In 1921 and 1922 diamond drill work was carried on from the underground workings to extend the depth of certain churn drill holes which had been lost in the original drilling and which had bottomed in ore. After this work was completed the diamond drill was also used to prospect some lateral extensions of the ore in a manner similar to the work previously done with raises. It was found, however, that in drilling up-holes with the diamond drill that the cost of the holes was practically the same as that of raising and this work was abandoned.

With the result of the diamond drilling as a stimulus, considerable thought was given by various members of the operating staff to the possibility of evolving some scheme of drilling long holes which would take the place of prospect raises. If such a scheme could be evolved it would bring speedier prospecting and eliminate the more expensive prospecting being done by raises. A number of plans were proposed, discussed, and discarded, and, until early in 1924, nothing ensued except conversation, but, about that time, the knowledge that the Chief Consolidated mines was successfully drilling deep holes with a hammer drill and jointed steel encouraged Mr. D. L. Sawyer, at that time geologist, to undertake the adaptation of a similar method to local needs. Through Mr. Sawyer valuable information and suggestions were obtained from Mr. Charles A. Dobbel, of the Chief Consolidated, and Mr. L. M. Cummins, of the Ingersoll-Rand Company, also assisted greatly in getting the long hole work started.

In August, 1924, the first long hole was drilled and, from that time on, at least one long hole drilling crew has been kept busy continuously, while over long periods of time there have been two crews. Up to the present time there have been drilled something over 700 prospect holes of an average depth of around 90 ft. Most of these holes have been out of the sides of drifts at an angle of 45 to 50 degrees upward, and have replaced the old-time prospect raises entirely. Many have been drilled at a flat angle, 10 to 15 degrees, from the horizontal out of the faces of drifts, but so far there has been no occasion for down holes. Long-hole drilling has also been used at Ray for tapping and unwatering old workings and for shooting down the back of stopes which have arched and failed to cave.

The machine used for long-hole drilling at Ray is an Ingersoll-Rand S-80, independent rotation drifter, which weighs about 220 pounds, and, as it is the heaviest and most powerful of its type, has an ample surplus of power over that necessary for the depth of hole and class of ground drilled. As at the Chief Consolidated, the necessity for mounting the machine on a cross-arm carried by two column bars was realized early in the game and with the rigidity thus obtained but little trouble is experienced in maintaining alignment of the holes. While lubrication by means of a line oiler has proven very effective, the drilling crew prefer to do without one rather than to sacrifice even the small amount of elbow room which it would take up.

The drill rods, shanks, and bits are made up from the same grade of steel as is used for all the drills in the mine and the section used is 1¼-in. hollow-round. The rods are made up in 3-ft, 6-ft., and 9-ft. lengths threaded for 3-in. on each end with an Acme thread, which is modified by a slight rounding at the top and base. The threads are cut by machine and are not heat treated. After the threads are cut the ends of the rods are faced by machine so that

* Assistant Superintendent of Mines, Ray Mines, Nevada Consolidated Copper Company.

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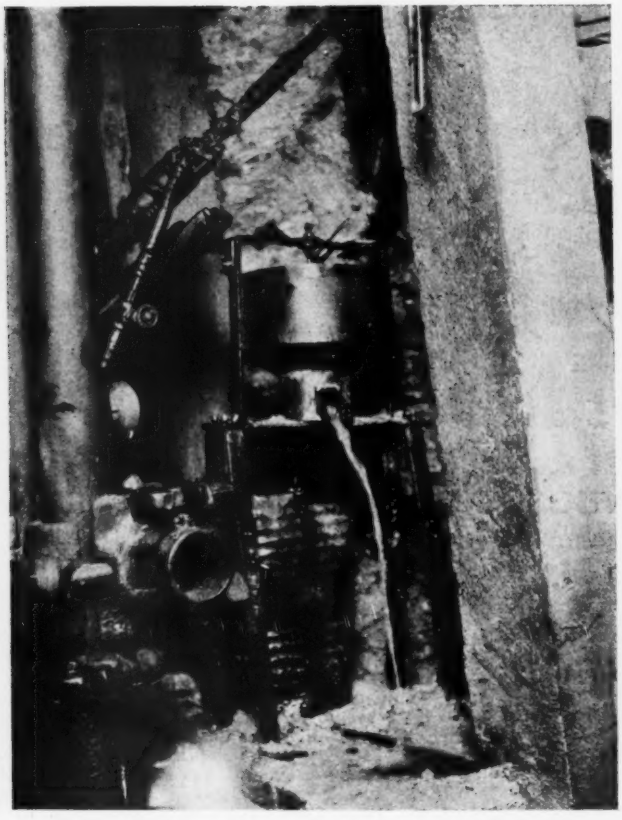
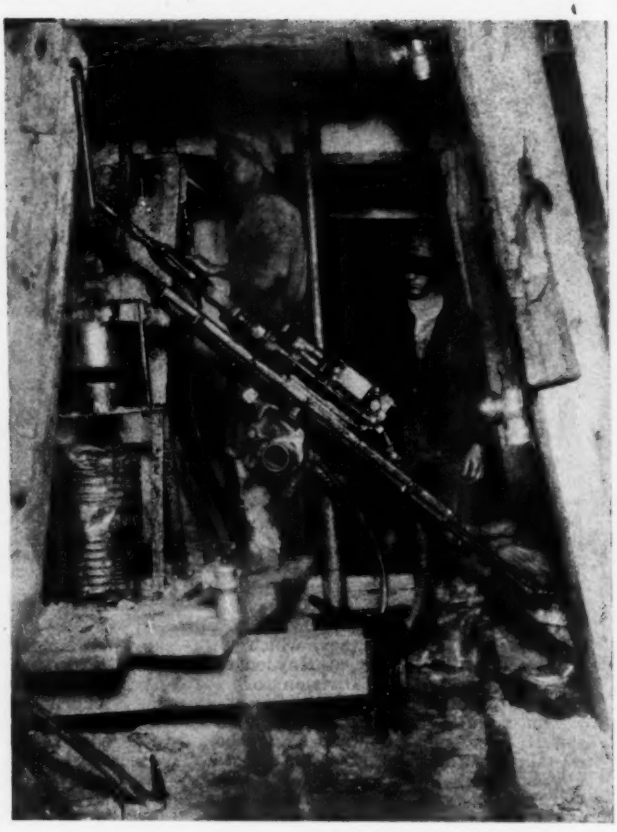




when they are coupled together the flush contact will insure an even distribution of the blow from the drill and also to help make the joints water-tight. The shank section is made up from a piece about 11-in. long, is plugged at the machine end, and tempered in an oil bath. One special rod section, locally known as the "adapter," is made up exactly as the longer rods but is only about 14-in. long. In the string of tools going from the machine this adapter connects the water swivel with the standard rods. Its use makes it unnecessary to break the connection at the water swivel when adding standard rods as the hole advances. The relative positions of shank section, water swivel, and adapter show up quite clearly in the accompany illustrations. In passing it should be noted that of the very little steel breakage which is experienced at the present time most of it occurs at the shank or in the adapter where the latter connects with the water swivel.

The bits are made from the same steel as the rods, starting with a piece about 18-in. long. They are threaded at one end and terminate on the other with a common 5 degree by 14 degree double taper cross bit, with a water hole in the side about 1 in. back from the cutting face. The gauge of the starter is 3½ in. and there are 13 reductions by eighths to the smallest bit which is 1⅞ in. When changing bits the steel is inserted or removed from the hole by two of the crew using 24-in. pipe wrenches of a special type which has been found particularly adapted to the work.

The use of certain alloy steels for bits has been tried out experimentally in direct competition with the steel being used. The best footage made by the special steel, however, was very little more than the average footage per bit of the ordinary steel over a long period of time. The only explanation which can be offered would seem to be in the point stressed earlier in this paper, and that is the soft, easy drilling nature of the average ground. Whatever the explanation may be, local opinion is that the higher first cost of the alloy steel and more particularly the complicated heat treatment which it requires are considerations which more than offset the comparatively small advantage which would accrue from its use. Made from steel which requires exactly the same treatment in sharpening as the balance of the steel in the mine, the long hole bits drill better than 15 ft. on the average, which means that ordinarily, in the standard 90-ft. hole, but five changes of bits are required after the starter has lost its gauge.

Some trial runs were also made with a special type of bit which had proven particularly successful elsewhere in very hard ground. The cost of this special bit, which was quite complicated in design, would be, even in quantity production, many times that of the ordinary bit, but when tried out in the Ray ground it did not do so well as the ordinary bit. Again the explanation would seem to lie in the soft nature of the rock.

The sleeve couplings for connecting the rods are made from cold-rolled shafting, cored and threaded with a special tap and surface carbonized by heating to a dull orange heat and treated for 15 minutes in a bath made from a commercial surface hardening powder. This makes them rather high as to cost, but the expense seems to be justified in the fact that these couplings give very long service before the threads become so worn as to make too loose a joint. As a matter of fact, the joint between couplings and rods is purposely made an easy fit to facilitate making and breaking connections and to assure contact between the ends of the steel at all times. The use of a heavy pinion grease on the threads and the flush contact between the ends of the rods, as before mentioned, makes a joint which is practically water-tight.

The water is introduced to the drill steel through a water swivel which is rigidly connected with the machine by side rods and, as previously stated, is interposed between the shank section and the adapter. The particular swivel used is one developed by the Ingersoll-Rand Company for long hole work, with certain minor changes which are the outgrowth of local experience. Wherever possible the water is introduced direct from underground pipe lines, but since on each level of the mine the water pressure at the shaft is reduced to 160 pounds, it often happens in remote setups of the drill that neither pressure nor quantity of water delivered are sufficient for efficient drilling. Shortage of water causes sticking and plugged bits and consequent breaking of steel, also a uniform sample can not be obtained with a thick sludge. For this reason whenever the water pressure is less than 50 pounds and the quantity delivered less than 5 gallons per minute, a small, air-driven pump and a small tank for water storage are used. The pump and tank are considered as part of the regular equipment. With the elimination of water trouble by use of the pump the plugging and sticking of bits and the consequent breakage of steel have been

greatly decreased. Before the pump was used, it frequently happened that considerable lengths of steel had to be left in abandoned holes. Since the first of the present year, the records show but 33 ft. of steel lost in this manner.

In the rather infrequent cases that a bit does become permanently stuck in the hole, a fishing tool is used for salvaging. This fishing tool, although in miniature, is in principle not unlike the horn socket used in recovering churn drill tools. It is made in two sizes, one for engaging the rod itself and one for engaging over the coupling. On account of the fact that the threading on the rods is longer than half the length of the coupling, a break just above a coupling leaves a few threads on the broken end of the rod. In such cases a new coupling on the end of a string of rods can often be used effectively in recovering the steel. One precautionary kink which the drill crew uses to lessen the chance of losing steel when the bit gets stuck is to select for the coupling back of the bit section one that has worn to a slightly looser fit than the others.

Further equipment consists of the sample containers, which are carbide cans with tops removed and wooden handles inserted across the opening. These containers, together with an automatic sampling arrangement which will be described, complete the list of necessary equipment at the site of drilling operations. A fairly good idea of the general layout at the hole is conveyed by the illustrations.

Before the use of the rotating sampler was adopted the collection and handling of the sludge was the most unsatisfactory feature of the work. It was necessary to string out a series of four or five carbide cans and collect all the water and cuttings discharged from the hole. Then, after allowing the contents of the series of cans to settle, the clear water was decanted or siphoned off until, when finally collected, the sample filled one or more cans and contained 50 or 60 pounds of cuttings. This laborious process kept one man constantly busy at the hole, and the general messiness and confusion which it involved, together with the difficulty and the time consumed in safely transporting such bulky samples from remote parts of the mine to the surface, may readily be imagined.

To do away with all this difficulty an automatic rotating sampler was developed in which all of the water and rock cuttings, or sludge, coming from the hole passes through a rotating cylinder which cuts out and saves about one-twelfth of the original quantity. Each final sample represents 6 ft. of drilling and its average weight, after drying, is between 3 and 5 pounds, varying with the size of the bit.

Six or 8 in. below the collar of the drill hole a second hole is drilled with the starting bit to a depth of about 6 in. This hole is used to support a galvanized iron spout, which serves to catch the descending water and sludge from the drill hole and discharge it into a funnel just above the rotating sampler. The rotating sampler consists of a short cylinder or shell of sheet iron connected by radial vanes or blades with a nicely balanced, vertical shaft at the center, on which it rotates; the impact of the water and sludge from the nose of the funnel just mentioned causes the rotation. All but one of the spaces between the vanes are open, and through them the bulk of the sludge and water is allowed to escape into the ditch. The one space which catches the sample has a bottom sloping steeply from the periphery of the cylinder towards the center, where the sample drops directly into the carbide can. Samples cut in this way were compared with the reject over a long period and found to check within 0.02 percent.

The average sample cut from a 6-ft. run is two-thirds of a carbide can, say, 6 or 7 gallons of water and sludge. This is allowed to settle and the clear water is siphoned off. When the sample is ready to come out of the mine, it amounts to only 3 or 4 in. in the bottom of the can and is easily handled without spilling.

About 20 of these samples are dried at one time on a flat-topped furnace, which is heated by waste wood from the mine and requires only an occasional firing during the shift. The dried samples are brought to the assay office, put through a ⅝-in. screen to break up the lumps, cut down to one-quarter their original size, and this quarter is put through the pulverizer to 80 mesh. This final sample, which is about 1 pound in weight, is rolled, and a spatula sample of 1 gram taken for assay by the cyanide method.

The direction of long hole prospecting is a function of the engineering department, the holes being called for at designated locations by the geologist, and the direct supervision at the hole being in charge of an engineer-sampler. The other members of the drilling crew are a machine man and a helper. In addition to general supervision of the work and personally handling the sample, the sampler assists in all the work connected with the drilling where a third man is necessary. Since the inserting and withdrawing of tools is accomplished entirely by man-power, all three of the crew must be husky men. The use of a block and tackle with dogs or clamps for the steel as an easier means for handling the steel and also as a safety measure was tried but was not particularly successful. With the inclination of the holes never more than 50° from the horizontal and the length of hole only 90 ft., the handling of the steel by man-power is not unduly hazardous, and this seems proven by the fact that in six years of drilling there has been but one accident, and that only a slight one.

In no small measure the success of long hole drilling depends on the skill of the machine man. At Ray he is picked only after he has demonstrated marked proficiency in handling a drill and has shown himself to be intelligent and conscientious in his work. Once having mastered the details of long hole drilling he gradually acquires a specialized skill, which stands him in good stead under the varying conditions encountered. He is paid a somewhat higher rate than the ordinary machine man, but aside from this he apparently takes a personal pride in the fact that his particular job entails greater responsibility than those of his fellows. No bonus is paid for extra speed or footage, since it is felt that the accuracy of results, which is the all-important object of the work, would be endangered by so doing.

The long hole crew of three men carry through the complete cycle of operating from the moving of the equipment from level to level or from drift to drift to the delivery of samples to the drying plant. They make necessary extensions of air and water lines to the place of work and, when necessity arises, put in a timber set at the drilling position. Ordinarily a timber crew from the mine prepares the drilling position in advance by standing a "long hole" set, which gives a working space 5 ft. square by 7 ft. 2 in. high in the clear.

The long hole sampler keeps the engineering office in close touch with the progress of the work by daily form reports covering all the activities of his crew. For each hole he keeps a separate log book in which he enters all data necessary for a complete record. This log book is sent to the engineering office upon completion of the hole, and the data it contains is combined with the corresponding reports from the assay laboratory for entry in a permanent record book and for plotting on maps and sections. After the assay results are obtained, each long hole is tagged with a small sign-board giving the position of the hole by coordinates, the bearing and length of the hole, and the average assay of the ground passed through.

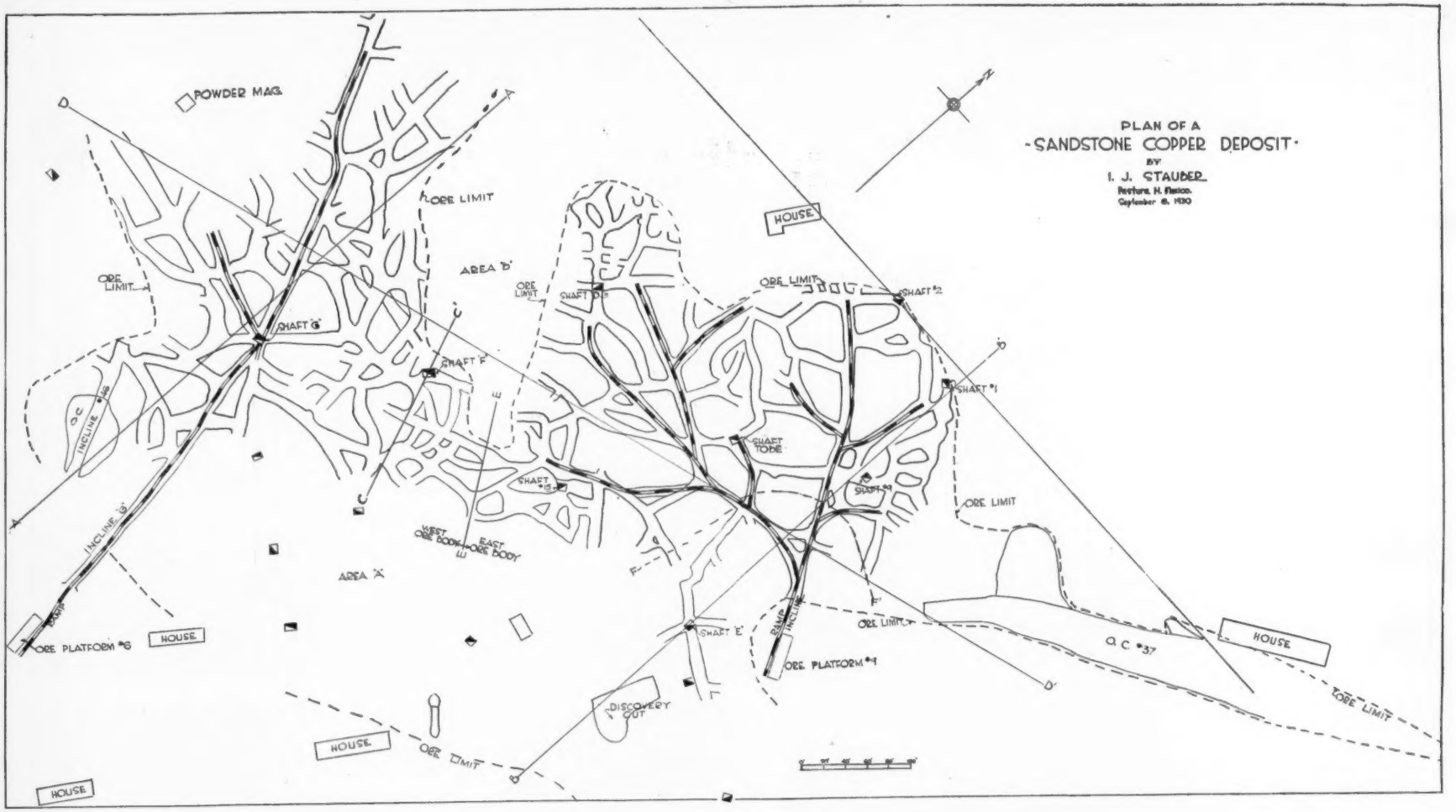
The accuracy of the results has been checked at various times by driving raises so as to carry the drill hole in one side of the raise. In each case the 6-ft. cut samples along the drill hole in the raise have given assay returns closely approximating the returns from the corresponding original 6-ft. sludge sample. With the reasonable accuracy of the total sample thus established, and the previously described tests of the sample from the rotating sampler against its reject, the information obtained by the long hole drill is sufficiently accurate for its purpose.

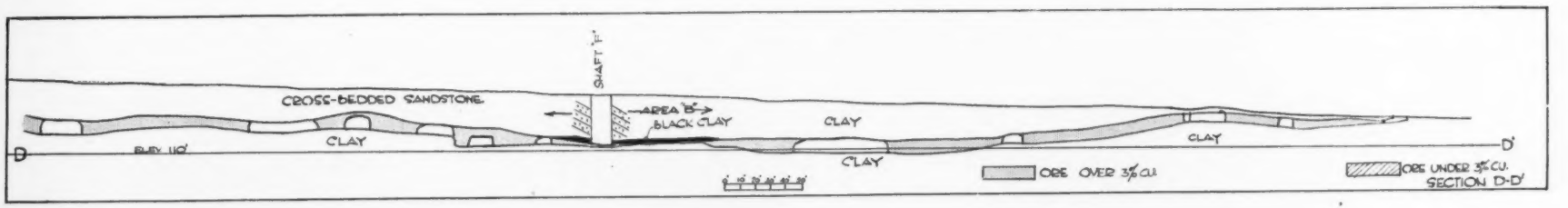
The efficiency of long hole drill operations as measured by feet drilled per crew shift has varied widely at times, due to location of the holes and the favorable or unfavorable conditions present. There have been monthly periods when the average distance drilled per crew shift has approached 30 ft., but the average efficiency of a four-year period is 18.06 ft. These figures are based on total shifts consumed in every phase of the work and not on actual drilling shifts alone.

The costs kept for long hole drilling vary from month to month, depending on the varying conditions encountered in the mine. The following tabulation, which is self-explanatory, shows the costs of this operation:

Year	Ft. per Mach. Shift	Cost per foot † Operating	† Mach. Shop	New Equipment	Total
1924	20.6	$0.65	$0.20	$0.16	$1.01*
1925	18.20	.78	.11	.16	1.06*
1926	21.62	.609	.078	.045	.732
1927	15.70	.82	.07	.07	.96
1928	16.23	.74	.09	.01	.84
1929	18.55	.794	.1062	.0783	.9785
1930 (½)	19.45	.6998	.0907	.....	.7906
Total	18.21	$0.7409	$0.0971	$0.0776	$0.91556

* Excessive cost due to charging out of all new equipment. † Operating—aside from regular drilling—includes drill sharpening, machine maintenance, and all drill steel and bits. Mach. Shop—consists of cutting and threading steel and couplings.


PLAN OF A
-SANDSTONE COPPER DEPOSIT-
BY
I. J. STAUBER
Pretura, N. Mexico.
September 6, 1930
POWDER MAG.
ORE LIMIT
AREA 'B'
SHAFT 'G'
SHAFT 'F'
SHAFT 'D'
SHAFT #2
SHAFT #1
SHAFT TOBE
SHAFT #3
SHAFT #5
INCLINE #3
INCLINE #2
WEST ORE BODY
EAST ORE BODY
AREA 'A'
SHAFT 'E'
RAMP INCLINE
ORE PLATFORM #6
ORE PLATFORM #7
HOUSE
DISCOVERY CUT
O.C. #37


SHAFT 'F'
CROSS-BEDDED SANDSTONE
AREA 'B'
BLACK CLAY
CLAY
BLUE LIG
ORE OVER 3% CU.
ORE UNDER 3% CU.
SECTION D-D'

A SANDSTONE COPPER DEPOSIT

By I. J. Stauber*

Looking north over the ore body

Open cut Number 36, showing ore dipping under surface

Open cut Number 37, showing ore dipping under surface

Location and Property

THIS property consists of 320 acres, a patented homestead which covers the mineral rights, located in Sec. 6 and 7 T 7 N, R 20 E, N.M.P.M. Elevation about 5,200 ft. The nearest rail and shipping point being Guadalupe siding on the Southern Pacific Railway and 250 miles north of El Paso, Tex.

This is a slightly rolling prairie country and so far as is known the ore is not associated with any instusives, faulting or mountain structure. There are no known igneous rocks within 40 miles. Oil geologists report some small dykes about 40 miles to the south in a flat prairie country where they would not be suspected.

History

One of the interesting things about any mine is why it started. A number of years ago a small patch of sandstone cropping carrying a small amount of copper was discovered by an Old Mexico Mexican who was employed on a section gang. This cropping is about 100 ft. in diameter and was the only evidence of mineralization. As shown on the plan map, a discovery cut about 10 ft. deep was made, and during the high war prices an attempt was made to produce ore. The sandstone here assays about 1.0 percent copper, except that it contains some bunches and nodules assaying about 8.0 percent Cu. There were not enough nodules and operation ceased at a loss after shipping about 12 tons. Later other parties put down a few shallow shafts to the north, and one, the Tobe (shown on map) showed about 5 ft. of 6.0 percent Cu. ore.

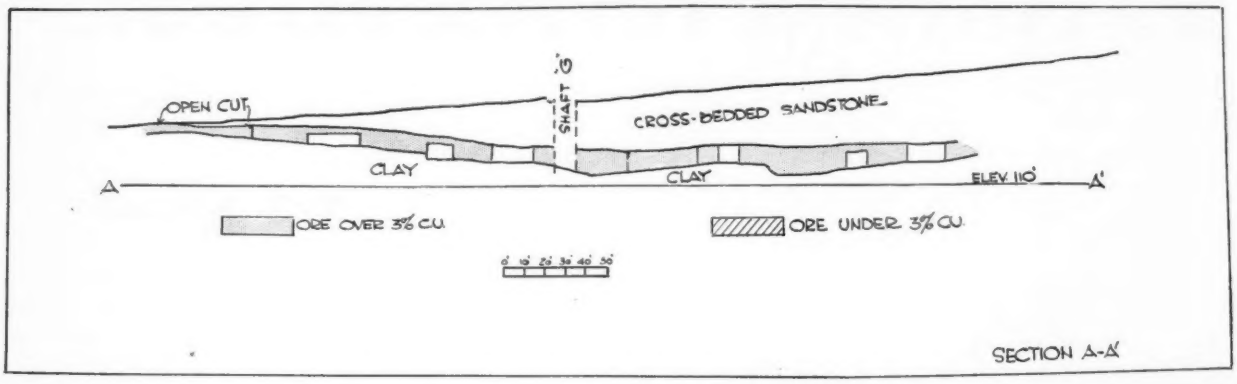
At this point I examined the property and decided there might be a concentration on the dip, as the discovery cut showed the sandstone dipping to the northwest, and the shafts in that direction showed a gradual improvement in the grade of ore; so I started operations in March, 1925.

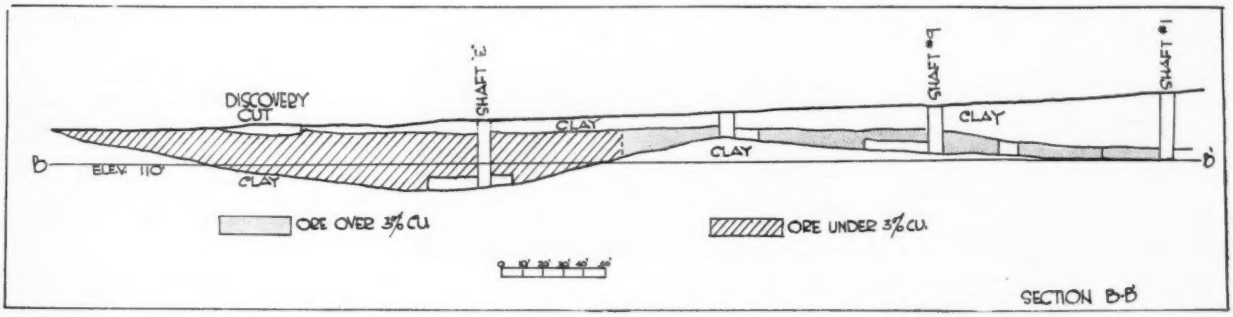
Drifts were started from the Tobe shaft, which was 17 ft. deep, and at the same time hand churn drilling was started. Using a set of ⅞-in. drill steel up to 22 ft. long two men could drill about 20 ft. of hole per day. Sampling was done with a ¾-in. pipe in sections fitted at the bottom with a home-made check valve. With these small holes and uncased the samples were diluted, and it was soon proven that the assays were running too low, but were useful in quickly proving up some ore tonnage. By July 1, 1925, shipments were started.

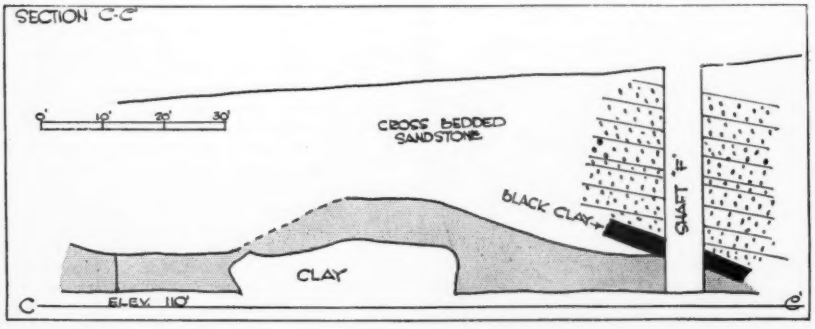
Development

So far as I know this is the most developed and most productive of any of the sandstone deposits in the United

* Owner and operator, Pastura, N. Mex.







States. Successful exploitation has been carried on for a short time only and at but few other places.

After finding ore in most all of some 50 drill holes a plan of shaft sinking was started, and drifting from these until all were connected. In this way certain ore limits were found, and all development kept in shipping ore. There are no waste dumps on the property. Drifts were made large and the ore thus mined about as cheaply as by any other system.

The East Orebody was found first (east of line C-C'). In this area there is from 2 ft. to 25 ft. of soft clay overlying the sandstone ore bed and averaging about 15 ft., and as no timbering was required these shafts cost from $60 to $100 each. The floor of the ore is a soft gray clay, carrying at times a slight iron stain. This clay floor exists over the entire mine area and while it is nearly level it soon proved to be too rough to use mine cars without taking up bottom, so the ore was trammed to the shaft by wheelbarrow frames made with a cradle to hold windless buckets. Later tracks were put in and light trucks with 350-pound capacity buckets and hoisting by "Whip," using a combination head frame and chute. Two men on top and a good mule hoisting about 24 tons ore per shift. At one time there were seven of these whip hoists in action, the crew and mules moving from one shaft to another to clean up. With this cheap outfit and cheap shafts it was found more economical to put shafts down often, rather than have a long tram; a tram of about 100 ft. seems to be the economical limit.

In this manner the ore body was developed, as shown on map, into a lot of irregular pillars. About two years ago it was decided to mop up the east ore body. By this time the flour contour was well known and main line mule haulage tracks were put in, the idea being to keep these tracks in thick ore, low floor places and avoid taking up bottom, the ore being gathered by wheelbarrows and being dumped directly into mine cars. On the south end a short incline brought the track to the surface and up a dirt incline and ramp 8 ft. high where the ore is dumped on the loading platform. Starting from extreme north and northwest limits of this east orebody, we robbed pillars and retreated along a more or less even line, and in this manner we have now retreated to line F-F'. Some posts were required but the timber and labor cost was less than 20 cents per ton. Mostly rejected railroad ties were used, costing delivered at the mine about 25 cents each. The clay roof proved to be troublesome; at times it would crumble off the headboards in nut size, and at other times break in blocks to slicken sides. There was one accident, a broken leg, from one of these blocks; otherwise, there has been no accident of importance in five years' operation.

Of course some pillars were lost, but we would work them down as small as possible, holding the roof with posts, and as we retreat, shoot the pillars we can not get and also shoot the posts to keep the country coming down. For the purpose of mine tax depletion a tonnage estimate was made of this *east* orebody, but the ore proved to be thicker than estimated so we have already extracted almost the estimated tonnage and have ore left. However, I would estimate that we do lose about 10 percent of the ore.

The west orebody is being put in condition for the same system of mining, but here we have a good sandstone roof so the ore will probably be mined with less loss and less timber. On the plan map it will be noted that the ore still continues to the west with no development ahead. If the ore continues much further in that direction we have about reached the point where it will be cheaper to start a shaft system again, rather than the long mule tram to loading platform "G."

Area "A" has been thought to be low grade, 1.5 percent to 2.0 percent Cu., but some recent development has shown up some high grade ore, so at least a portion of this area can be mined by selective mining. This ore is from 12 ft. to 20 ft. thick, with from 2 ft. to 6 ft. of overburden.

Open Cut No. 37 was so near the surface that it was stripped with teams and scrapers and quarried, and there is another area surrounding Open Cut No. 46 to be so mined.

The total production to date as follows:

Year	Dry Tons		Ave. % Cu.
1925	3,278	6 mos.	5.24
1926	6,667		5.10
1927	6,511		4.60
1928	11,589		4.56
1929	16,187		4.75
1930	10,429	8 mos.	4.88

Owing to the present low price of copper, operations suspended August 20, 1930, except that a few men will be kept on to develop to the west, also to better develop Area "A."

Average analysis of a six-month composite sample:

Ins.	83.0%	
SiO2	80.9	
Fe & Mn	1.8	
CaO	0.5	probably as gypsum
Zn	1.7	
S	0.3	
Al203	1.7	
Ag.	0.2	Oz.

Spot sampling failed to show any silver enrichment at any point.

The ore is remarkably uniform throughout the mine and is not sorted. Hauling is by contract at 55 cents per ton, the teamsters load and unload by hand, making 4 (sometimes 5) trips per shift and averaging 5,300 pounds per wagon trip; it is a gentle down slope to the railroad and all ore is shipped to the El Paso smelter.

Mining is by contract hand drilling at 25 cents per foot of hole drilled, a good driller making from 15 ft. to 18 ft. of hole per shift. Poorly placed holes are rejected at time of measurement, which is daily. About 4.5 ft. to 5.0 ft. of hole is required per ton of ore. All other labor, top and tramming, paid $2.75 per day, mules $1 per day each. The mine is operated one shift per day only.

There is no machinery on the mine. The average thickness of the East Orebody is about 7 ft., varying from 2 ft. to 12 ft. The average thickness of the West Orebody is about 8 ft., varying from 5 ft. to 14 ft.

Geology

As shown by the sections this is a bedded deposit in sandstone with a clay floor probably 25 or 30 ft. thick and with a clay roof over the East Orebody and cross bedded sandstones over the West Orebody. The overburden at times carrying small bunches and layers of copper ore. At one time it was thought this clay floor might be a much altered igneous sill but microscopic examination in New York return it as "sericite-quartz-schist derived from weak metamorphism of sandstone." If it ever was a sandstone no structural evidence remains. Section C-C' shows an extreme type of floor hump. At times they resemble faults, but are not. This particular hump is circular and about 35 ft. in diameter. It certainly is not a fold and it seems certain no clay or mud could ever have been deposited in such shapes. I have been unable to find any grading from the ore sandstone to the floor clay. The roof of the ore is also very sharply defined. The ore is mostly malachite and azurite with a small amount of chrysacola and black copper oxide, replacing the cementing of the sand grains. A laboratory test on a car lot composite showed 96 percent of the copper is soluble in 5 percent H_2SO_4 in a few minutes. Ninety-six percent of the copper is carbonate and about 3.5 percent is sulphide.

A few replaced logs have been found assaying 47.0 percent Cu., but they are not of importance, one being about 40 ft. long and 10 in. in diameter.

Within a radius of 20 miles there are dozens of prospects and croppings but somehow they do not look promising. They are scattered over different geological horizons down to 1,500 ft. below this deposit.

There is considerable water in this district at a depth of about 300 ft. but contains considerable gypsum and is unfit for use. The mine makes a small amount of good water but only sufficient for camp stock.

The West Orebody has a different appearance, carrying a good many nodules but averaging about same copper content as East Orebody. It carries considerable copper-iron-sulphide mineral, probably bornite, select pieces assaying 47.0 percent Cu.

In *Area "B"* there is from 2 ft. to 3 ft. of black shaley clay over the ore. As shown on Sec. C-C', there is some evidence that the edge of the ore has here been erroded prior to the black clay. Around this Area "B" the ore limits were determined by the ore getting too thin but good thin ore does extend into this area. It is just possible that this area will determine the origin of this copper to be either an old stream bed or lake of copper concentration from which the copper filtered down into the porous sandstone beneath and was precipitated by organic matter, etc.

On the other hand, westward development is getting under a small area of heavily iron stained sandstone; it is the only stained sandstone in the district; at all other points it is light gray. This iron stained sandstone is another bed about 50 ft. above the ore bed. So the genesis of this deposit is still in doubt.

The ore bed is a medium grain gray sandstone considerably cross bedded classified by the U. S. G. S. as Santa Rosa sandstone, Triassic, and is about 150 ft. above the permian Red-Beds.

The northern border of the ore body is rather sharply determined by the copper values playing out with the sandstone bed continuing with a light red iron stain. At times the limit is so sharp that one side of a drift will be shipping ore and the other side waste.

The southern boundary of mineralization is marked by the edge of the ore bed coming to the surface or nearly so. It has the appearance of being a tipped up erroded edge but no work has been done to determine whether this is an erroded anticline or not.

While the ore is fractured in all directions, still the main trend is southwest about parallel with the strike. Some fractures have a vein-like appearance filled with rich ore; others show a decided leaching near the fracture. As a general rule the bottom of the ore bed is richer and in nearly every case there is a decided enrichment of a few inches adjacent to sharp floor humps and benches.

While the floor is quite bumpy, the roof is much more regular.

General

It is difficult to compare one sandstone deposit with another. I have looked at a good many so-called Red Bed deposits, and believe some are due to stream beds, others lake beds, and others associated with intrusives. Too much work has been done here to form an opinion, but one thing seems certain—this deposit has been worked over and concentrated to its present condition.

Deposits of this type are scattered over a large area, including parts of New Mexico, Arizona, Utah and Texas and, as I see it, are no threat to the copper industry but rather a source of supply in the distant future. No doubt there are other deposits as good or better than mine, but how to find them I do not know.

AIR ANALYSES

(*From page* 922)

ribs was very loose. The management then decided to construct concrete-block seals. In cutting a hitch in the rib where the loose coal was found it was necessary to cut through considerable coal containing several large cracks, requiring a cut about 2 ft. deep before solid coal was found. After the fire area was opened it was found the loose coal extended 8 ft. outby and 14 ft. inby the seals. It is presumed that the concussion due to shooting in the vicinity of the seals jarred the loose coal, permitting the air to pass through the cracks and thereby increasing the oxygen in the sealed region.

The concrete seals were completed on September 15; and on September 25, 10 days later, another set of samples was collected. These samples showed that the oxygen content dropped from 7.75 to 1.6 percent. After the receipt of these analyses it was decided to open the fire on October 5. This was done, and the fire was found to be extinguished and the fallen material cool. Doubtless this fire region could have been opened much sooner if the seals had been properly constructed in the first place.

The analyses of the air samples collected in Mine 3 show only 9.6 percent of methane, about the lowest percentage of methane the writer has found behind sealed fire regions in mines liberating methane.

However, in this mine there are sections making considerably more methane than that found in the sealed territory.

The U. S. Bureau of Mines gives a course in Advanced Mine Rescue Training that describes the properties of mine gases, methods of detecting them, such as the Orsat apparatus for general air analyses, the Burrell indicator for methane, the pyrotannic acid method and the hoolamite detector for detecting carbon monoxide, the use of various types of apparatus that afford the wearer protection from irrespirable gases, the sealing and un- (*Continued on page* 935)

MANAGEMENT *in its* Responsibility to Industry

By W. V. DeCamp*

WHEN requested to present a paper before this body on some subject of a technical nature covering a portion of the operations of the United Verde Copper Company, I felt that the subject of Industrial Relations would probably be of more general interest than the discussion of a specific technical problem. I have, therefore, confined myself to a few observations on the responsibility of management to industry, an understanding of which appears so essential if industry is to continue its rapid rate of progress in this country. The responsibility of labor is of equal importance, but since space and time is insufficient, I am assuming that we will grant an equal or co-responsibility on the part of labor with management.

Those engaged in metal mining have long realized the alarming results that follow the peaks and depressions that occur in the industry, and have sought a solution through propaganda, legislation, advertising and attempts at stabilization, with the net result that peaks and depressions continue to follow the peaks and depressions common to the general run of business. The answer seems to be that when general economic conditions are good or bad, the metal industry is in a comparative condition.

As indicated by Mr. Owen D. Young, chairman of the General Electric Company, in an address before the National Electric Light Convention, we are confronted with a general surplus in all lines of industry, whether it be cotton, copper, oil, automobiles, manufacturing plants, or men. The solution is not possible within our own borders, and we must look to foreign trade to take care of these surpluses. We are, therefore, involved in an international problem, rather than a national one.

Many firms and even industries long ago recognized the need for expanding markets, and as you know have not only developed extensive foreign trade but have even established manufacturing plants in foreign countries, with a view to adapting our machine methods to the cheaper and yet potentially efficient labor available.

You might immediately question the advisability of high tariff provisions if you admit that foreign trade is essential to our continued prosperity. It is probable that we are rapidly reaching a state wherein a high tariff will be generally recognized as inimical to our future prosperity, though this may be preceded by a tariff war, after which normalcy will be reached. An effort may even be made to generally abolish tariff protection.

The demonitization of silver has brought home to many of us the realization that high silver prices are dependent on foreign use of the metal, while our copper export association has also approached a realization of the same fact.

Conditions in the metal industry, since we are located to a large degree at isolated points in these Western States, are slightly different than those in the industries established in the centers of greater population. Our people are transitory, and when we curtail operations the effect on both the operation and the industry is almost disastrous.

Although our business is handled in larger units, we are still almost as vulnerable to price and seasonal changes as the individual agriculturist in the conduct of his small farm, or the small business man or manufacturer.

Stabilization of the industry or of prices and wages may appear logical at first sight, but there are many factors that prevent complete stabilization; and no doubt in the minds of some, complete stabilization in any industry would spell the death of competition, the loss of individual initiative, and eventually the destruction of democracy. If you interpret stabilization as specific price fixing, you are pursuing a wraith that may never be captured, though stabilization between minimum and maximum figures is a possibility and is conceivable and practicable to a large degree.

We have long been confronted, when considering stabilization or the adjustment of supply to demand, with the possibility of violating the Government regulations in this regard; but today the Government does not concern itself in this matter, nor evince its former attitude on matters of combinations, since they realize as never before that undue regulation is inadvisable and that there are other matters of even greater concern.

We find some mines that can produce cheaply, and they object to combinations that will tend to regulate their rate of production; we find others whose costs are so high that only extensive price fixing at a high rate would permit continuous operations. We are confronted with the custom smelter, which though invaluable to the industry is frequently accused of having no interest in production costs but only in the transfer of a maximum amount of metal through its plant.

We find the potential productive capacity of many plants increased under the stress of high prices to a figure far beyond the ability of the world to consume. Such plants stand as a menace to any attempt at stabilization until such time as consumption increases, and then we proceed to enlarge our plants again, and may even under the control exercised by strong groups force prices temporarily to a point where maximum profits are obtainable.

Each of you in the conduct of your particular operation would enjoy a comparatively uniform rate of production. If asked why, you would answer that you can better regulate and keep costs at a minimum under such a program, and if analyzed this means that labor conditions, which generally represent 50 percent of your local costs, are stabilized. Your employes marry, raise families, accumulate some of the essentials and a few of the luxuries; accidents, labor turnover, discontent, and radicalism decrease, and you are on a fair way to efficient operation, even though years may be required to reach this condition.

During this period, realizing that the above conditions are ideal, and in an effort to maintain them, you undertake better housing of employes; establishing of recreational features becomes a part of your policy; you provide good working conditions in your mine and plants; you may even supply life insurance, increased medical facilities, health and accident insurance or funds.

You establish a promotion system in the organization, after overcoming your fear of having a trained man available to take your place, and may extend this system down through your organization.

You may even have acquired a broad-gauge viewpoint on safety work, whether prompted by the desire to safeguard your fellow-man or by the more materialistic viewpoint that safety pays dividends. You may have gone further along humanitarian lines and established bonus, task or contract systems for the various lines of work, provided you are sufficiently well-informed and courageous to realize that when properly handled such systems are a boon to the industrious employe and materially reduce costs.

If conditions permit, you might have introduced a method of stock purchases in your company by your employes, or permit them to purchase savings certifi-

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cates that would give them a competency in old age or enable them to weather a period of unemployment. In this you might go even as far as our postal department, or some foreign countries, deducting a certain percentage of the wage from each shift's work to apply on a pension fund, returnable to the employe when he leaves the organization or when he retires after reaching the age limit.

The humanitarianism indicated in the items mentioned above does not become paternalistic unless it fails to pay dividends, or unless it fails to teach the employe to become self-reliant. However, unless you have done some or all of these things, then you should take stock of your organization, since these things are being done by many organizations in this country today. Also, some states have adopted certain of them, and in Europe entire countries are committed to others.

We will grant for the time being that you recognize the fact that the above policies are not paternalistic; that they pay dividends; that participation by the employe in those that require cash outlay on his part is making him self-reliant.

We will grant that labor conditions in your plant are highly satisfactory—and about that time the inevitable happens: the bottom drops out of your metal market. You are notified overnight, and in turn notify your employes, that a reduction in force of 10, 25, 50, or 100 percent will take place immediately.

Of what use is all your humanitarianism when your employe is confronted with uncertain employment? Just what do you think his reaction is? Can you expect him to feel kindly toward the company or the industry, even though he is entirely fair minded? Does he not feel that you are the one who has failed, rather than himself; does he not then begin in his mind to tear down those gods of industry he has set upon a pedestal, and does he not begin to feel that he would better be able to administer the affairs of the industry, or even the nation, himself?

Nothing tends to the destruction of morale in the employe more than irregular employment, and following long-continued and tremendous peaks and depressions that are arising out of our advanced civilization and ability to produce, one can readily visualize a bureaucratic control of government regulation so easily brought about through the dissatisfied voting employe. State-controlled pension systems or state-controlled unemployment doles or unemployment insurance in which the individual does not participate in an equable manner can very easily arise, just as they have in other countries—with the destruction to initiative and democracy that follows in their wake.

You say this is not only the problem of the metal mines, and you are correct; but your part is very clear, in that your industry is a major one and controls the activities of a multitude.

You must assume the responsibility of continuous production, and to do so you must realize fully what present conditions are and then work to the end that at least a major portion of your employes are granted the privilege of full-time operation.

We have all been too prone to extension of plant capacities without realizing that for every metal mine there is a certain range of production that is justified in normal times. We frequently forget that man may build a plant of enormous capacity, but only God was privileged to make the ore body designed to supply the plant.

Every mine has a basis of production which is more nearly correct for that mine than any other rate, and you as technical advisers should be in a better position to determine that rate than any other. You are also in a better position to analyze conditions and determine just when additional plant capacities should be added. How many times have you built such extensions, how many times have you crowded development and exploration work during the peak of metal prices, only to find on completion that your peak has passed, that your extensions have been completed during high prices and high wages, and even improperly designed, due to the rush and hurry that accompanied your program.

Would it be too much to ask the exercise of a foresight and understanding of conditions that would enable you to produce when the going is good and prices high, and retain a reserve that would permit mine plant extensions at a time when low wages and low-price materials were available?

When the near-sighted employe comes before you and states he is broke after a long period of high wage employment, your natural tendency is to say, "Go to the ant, thou sluggard—store up your funds during prosperous years to carry you through lean years." Am I unreasonable to ask if you yourself adopt this policy, or does the company which you represent endeavor to carry a sufficient emergency reserve to assure at least partial operation, and does it use that reserve for that specific purpose of maintaining in employment as large a number of men as possible?

Have you delved into the intricacies of metal sales and metal consumption to a point where you realize the benefit that has accrued to some of the larger metal consolidations that have made of the producer a manufacturer as well as a seller of his product, instead of a mere producer at the mercy of any variation that may occur in the demand for your product?

You look with favor on consolidations such as the fruit growers and innumerable other associations inaugurated for the production and marketing of their products, but have you exhibited the same degree of intelligence in your problem?

Do you expect forever to sit in dread of governmental regulations without asserting your rights, and then ultimately be forced by the dissatisfied voting employe into regulation far more drastic than is at present conceivable, or are you as an organization willing to take up to a greater extent than ever before the careful investigation of this problem, and then through your influence in the industry inaugurate a schedule of operation, a schedule of manufacture and sales, a schedule of foreign relations, that will eliminate a portion at least of these fluctuations? To do this there must be a realization on the part of each producer that the individual selfishness he has exhibited in the past is the one great bar to any attempt at stabilization of the industry. He will not stay put under any type of agreement if he sees even a temporary opportunity to better himself for the moment by walking alone. The strictly custom plants have just as much to gain as any other independent producer, since continued operation of the plant is a necessity and far more profitable under reasonably stable rates of production or operation than otherwise.

You immediately say in answer to those questions, "This all sounds good, but actually it is visionary and impossible of accomplishment." But do you realize that a great number of able men and well-managed industries have faced this question fairly and successfully?

Possibly you know that for many years man has considered the advisability of promoting public works during periods of depression, and yet nothing has been done until too late, and then inadvisedly. Your present administration, however hampered though it may be by an insufficient provision for such work, is the first to publicly announce and accomplish anything in the direction of increasing public expenditures.

The Proctor & Gamble Company for many years have been able, by farsighted investigation of their markets and by expanding their facilities through a greater number of jobbers, to guarantee their employes 48 weeks of work annually, and have actually operated over 49 weeks.

Other people and other industries have realized their responsibility to labor as well as the increased profits arising out of steady production, and I doubt if the expression is justified that such methods are not applicable to the metal industry.

Quoting further from Mr. Young:

"It is ridiculous to speak of unemployment as a necessary condition of human society. It is nothing more than a maladjustment of its machinery, a drain on our sympathy, and a promoter of unintelligent charity. Markets are available, but we must use the same give-and-take methods in our foreign relations that we use at home, involving exchange of goods and credit, and when our international policy approaches the policies of fairness of exchange within our own borders, then we can hope for a solution. In industry if we can not consume our product we must face unemployment unless our products can be marketed elsewhere."

The American Mining Congress is the logical organization to undertake the thorough study that is necessary if any progress along the line of stabilization in our metal industry is ever to be made; and, gentlemen, it can not come through legislation, but must come through the only possible channel open to it—the education of each operator to a realization of the seriousness of his problem. Following this realization must come the setting up of the necessary program that will permit its partial accomplishment, keeping always in mind that the answer lies with the individual producer and the degree of sanity and wisdom and fairness he is willing to exhibit for the benefit of the industry as a whole. He should be strengthened further by the realization that should he fail then that multitude of faithful employes whom he so carelessly cast aside when they are not needed may take this matter into their own hands. Such a result would lead the producer along paths that end in strict legislative action, and to a degree of control of his operations that would be drastic and fatal to the future of all industry within his own borders, and a bar to the extension of foreign trade so vital to the general situation.

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METALLURGICAL and EFFICIENCY RESULTS at the SELECTIVE FLOTATION MILL

of the Black Hawk Consolidated Mines Company

By Ira L. Wright*

THE Black Hawk selective flotation mill has been described in the January 26, 1929, issue of the *Engineering and Mining Journal* and a paper, "Milling Methods and Costs at the Black Hawk Concentrator, Hanover, N. Mex.," has been published by the Bureau of Mines. Since the publication of the first article certain changes in equipment and flow sheet increased the capacity of the mill from 100 to approximately 175 tons in 24 hours. At the present time 85 to 90 percent of the mill feed is custom ore produced by the Ground Hog unit of the Asarco Mining Company. The other 10 to 15 percent comes from the Combination mine of the Black Hawk Company. The two ores assay about as follows:

	Asarco	Black Hawk
Gold	Trace	Trace
Silver	7.0	2.5
Lead	8.0	5.0
Copper	3.5	.6
Zinc	16.0	12.0

It is apparent that the mixing of these two ores in the proportion mentioned makes a mill feed of exceptional richness. It is not unusual to obtain a ratio of concentration of less than 2: 1 (Feed: Lead and Zinc Concentrates). In concentrating such ore on a custom basis it is essential that the miller have prompt and accurate information as to both metallurgical and commercial results. The two are seldom the same even when concentrating only one metal, but when four metals must be considered the highest recovery of the metals may fall far short of the highest recovery of dollars and cents. For instance, when zinc is selling at 4.75 cents per pound and using the present Black Hawk smelting and freight costs it is more profitable to make a 57 percent zinc concentrate with only 70 percent recovery than a 50 percent concentrate with a 90 percent recovery. At the Black Hawk mill commercial as well as metallurgical recovery is calculated daily.

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SAMPLING

All custom as well as company ore is sampled dry after passing through a Symons cone crusher which reduces the ore to minus one-half inch. One and six-tenths percent of the stream discharging into the fine ore bin is cut out by means of buckets suspended between sprocket chains. Four cuts of the entire stream is taken per minute. The sample for one lot of about 250 tons is accumulated in a steel bin. This sample of approximately 4 tons is passed through rolls set to give —4 mesh. A cut of about 100 lbs. is taken out of the discharge of the rolls by means of a southwestern sampler speeded to pass its channel through the stream 7 times per minute. This sample passes through a grinder which reduces it to —10 mesh and is then quartered through Jones splitter to the proper amount for pulverizing to —100 mesh for the assay office. Metallurgical samples are taken as follows:

Heads: Classifier overflow.

Lead Concentrates: Lead recleaner flotation machine.

Zinc Concentrates: Zinc recleaner machine.

Tails: Discharge from final zinc rougher flotation machine.

These samples are taken for each of the 8-hour shifts. If rate of feed has been constant or nearly so an arithmetical average of the shift samples is taken as the result for the 24-hour period. If feed has varied or there has been a shut down in any shift weighted averages are figured.

Metallurgical results are calculated by means of the usual three product formula. Lead and zinc assays only are used in the calculation to obtain recovery of lead in the lead concentrate and zinc in the zinc concentrate. The distribution of the silver and copper to these concentrates is made by applying the assays to the weights of products obtained by the three product formula. The total silver and copper in zinc and lead concentrates and tailings figured in this manner seldom equals exactly the quantity in the heads.

The following table shows assay of products and calculated recoveries for July 28, 1930.

ASSAYS:	Tons Milled 159.6			
	Silver	Lead	Copper	Zinc
	Oz.	%	%	%
Heads	9.7	12.1	4.1	17.2
Lead Concentrates	33.0	43.0	14.3	7.1
Zinc Concentrates.	3.1	2.7	1.4	57.9
Tailings	.8	.6	.1	1.9
RECOVERIES:				
Lead Concentrates	88.08	92.00	90.30	10.69
Zinc Concentrates.	7.96	5.56	8.57	83.88
Tailings	4.06	2.44	1.13	5.43
	100.10	100.00	100.00	100.00
Dry Tons Lead Concentrates	41.32			
Dry Tons Zinc Concentrates	39.25			

WEIGHTS

Crude ore is weighed on 4-ton Howe track scales and moistures taken before being dumped into coarse ore bin. At 7 a. m. each day an estimate is made of the tons ore in coarse and fine ore bins. Tons treated equals estimated dry tons on hand 7 a. m. beginning of 24-hour period plus dry tons weighed into coarse ore bins less estimated dry tons on hand 7 a. m. end of 24-hour period. Ratio of concentration as found by the three products formula applied to dry tons milled gives tons concentrates produced. Since the accuracy of this calculation depends on the accuracy of the estimate of tons on hand, the sampling and the assaying it is not expected that the weight of concentrates so obtained will be exact for any particular 24-hour period, but over a month's time the ac-

Tons Treated 159.6

Assays Heads		Concentrates made Lead	Concentrates made Zinc	Standard Concentrates Lead	Standard Concentrates Zinc
Silver	9.7	33.0	3.1	32.1	.....
Lead	12.1	43.0	2.7	40.0	.....
Copper	4.10	14.30	1.40	13.56	.....
Zinc	17.2	7.1	57.9	.....	56.0

Lead in "Standard Lead Concentrate" assumed to be 40%.

Copper in "Standard Lead Concentrate" $\frac{40 \times 4.1}{12.1} = 13.56\%$

Silver in "Standard Lead Concentrate" $\frac{40 \times 9.7}{12.1} = 32.1$

Zinc in "Standard Zinc Concentrates" assumed to be 56%.

Tons "Standard Lead Concentrates" in ore.

Lead $\frac{159.6 \times 12.1}{40} = 48.28$ tons.

Value f. o. b. mill, 48.28 tons @ $48.68 ..... $2,350.27

(Quotations of metals for July 28, freight and smelter rates applying to Black Hawk concentrates used in figuring these values.)

Zinc $\frac{159.6 \times 17.2}{56.0} = 49.02$ tons.

Value, 49.02 tons @ $14.81 ..... 725.99

Total value "Standard Lead and Zinc Concentrates" $3,076.26

Amount and value of concentrates actually made as obtained by metallurgical recovery formula:

41.32 tons lead @ $52.02 = $2,149.47
39.25 tons zinc @ 16.23 = 637.03

Total value $2,786.50

Commercial recovery $= \frac{\text{Total value concentrates actually made}}{\text{Total value "Standard Concentrates"}} = \frac{2,786.00}{3,075.26} = 90.6\%$

cumulated weights so obtained correspond closely to smelter weights.

On the 1st, 8th, 15th and 21st of the month great care is used in measuring the amount of concentrates on hand. As soon as railroad weights of concentrates shipped during the month prior to these dates is obtained the accumulated tonnage estimated by the metallurgical calculations is corrected to conform to the railroad weights. To obtain dry weights from railroad weights moisture is assumed to be 10 percent. By making these weekly corrections the estimated cumulative weights of concentrates produced during the month never gets far off and the total is always within .5 percent of that shown by returns from the smelters.

Value

The net value of concentrates f. o. b. cars at the mill is figured daily. Quotations of metals are obtained from the daily papers. Except in periods of violent fluctuations the value of concentrates figured from these quotations is very close to that obtained at the smelter. The estimated cumulated value of a month's production has not varied more than 1 percent from smelter returns.

Commercial Recovery

The prime object in milling a ton of ore is to produce that concentrate which will bring the greatest return in dollars and cents. Given the mineralogical composition of an ore it is possible to figure the analysis of concentrates that would be obtained by perfect recovery and separation. If we assume the analysis of these perfect concentrates as standard for the average ore being treated in a mill then it is possible to figure the net value of a crude ton of ore if perfect recovery and separation and "standard concentrates" are made. If the value of the concentrates actually made is divided by the value of the "standard concentrates" a commercial recovery is obtained.

At the Black Hawk mill this "commercial recovery" is the most important guide in controlling metallurgical work. If high recovery of all metals and a good grade of concentrates is made the "commercial recovery" is high. If high recovery but low grade concentrates is made the "commercial recovery" will be lowered. In controlling mill operation to secure the highest "commercial recovery" the following factors must be considered: Metallurgical recovery, freight on concentrates, smelting rates on concentrates, price of each metal.

Shown above is the calculation of "commercial recovery" for July 28, 1930.

It will be observed that the grade of concentrates actually made on this date was slightly higher than that of the "Standard Concentrates." This shows that for this particular ore the grade of the "Standard Concentrate" might have been assumed to be higher than the standard being used. This is of no great moment as it merely results in the "Commercial recovery" being slightly higher than if only standard grade of concentrate had been made.

The calculation in the small table brings out strikingly the drop in "commercial recovery" due to making lower grade concentrates though metallurgical recovery may remain nearly the same. Assume that these products had been made on July 28.

ASSAYS:	Silver Oz.	Lead %	Copper %	Zinc %
Heads	9.7	12.1	4.1	17.2
Lead concentrates.	28.8	38.0	12.31	10.0
Zinc concentrates.	3.1	2.2	1.4	50.0
Tails	.7	.4	.1	.5
RECOVERIES:				
Lead concentrates.	88.01	93.50	89.41	17.30
Zinc concentrates.	8.94	5.09	9.56	81.46
Tails	3.05	1.41	1.03	1.24

Commercial recovery $= \frac{2,560.03}{3,076.26} = 83.2\%$

(Calculated in same way as above.)

Note that metallurgical recoveries would have been nearly the same as those actually made but that "commercial recovery" would have dropped 7.4 percent due to drop in grade of lead and zinc concentrates and the value of concentrates would have been $226.47 less for the day or $1.42 per crude ton less than that actually made.

AIR ANALYSES

(From page 931)

sealing of mine fires, and the procedure in case of explosions. The officials of several companies in Illinois have received this training once, and a few of the companies have had their officials take the course two and three times. The course is free, and all mining companies should make it a point to have their officials and other competent workmen take this training.

It is believed sufficient information is presented in the foregoing tables and discussion to show the value and necessity of air analyses for determining the quality of air in the mines and the proper time for unsealing fire regions.

Bureau of Mines engineers recommend that all coal companies equip their safety departments with apparatus for air analyses and thereby obtain the benefit of the information derived from this source.

Those who desire further information on air analyses and how to collect air samples, the properties, physiological effects, protection from, and detection of mine gases, sealing and unsealing mine fires, and procedure in mine explosions, are asked to write to the U. S. Bureau of Mines, Washington, D. C., for the following publications published by this bureau:

Miners' Circular 33, Mine Gases and Methods for Their Detection, by J. J. Forbes and G. W. Grove.

Miners' Circular 34, Instructions in Methods of Sampling and in the Use of the Bureau of Mines Portable Orsat Apparatus for Analyzing Mine Gases, by W. P. Yant and L. B. Berger.

Miners' Circular 35, Protection Against Gases Encountered in Mines, by J. J. Forbes and G. W. Grove.

Miners' Circular 36, Suggested Procedure in Sealing and Unsealing Mine Fires and in Recovery Operations, by J. J. Forbes and G. W. Grove.

Bulletin 197, Sampling and Examination of Mine Gases and Natural Gas, by G. A. Burrell and Frank Seibert; revised by G. W. Jones.

All samples listed in this paper collected by officials of the coal companies or engineers of the U. S. Bureau of Mines, were analyzed by the U. S. Bureau of Mines gas laboratory, at Pittsburgh, Pa.

A very interesting map of Canada, on a scale of 100 miles to the inch, that indicates the resources of the Dominion, has been prepared by the National Development Bureau, Department of the Interior, at Ottawa, Canada. Copies may be obtained free of charge from the aforementioned bureau.

Curtailment in Production Recommended by Copper Institute

A reduction in current copper output sufficient to prevent an increase in the existing stocks was recommended to the industry November 13 by the Copper Institute, acting in behalf of producers representing about 90 percent of the world's output. The institute's announcement, summarizing discussions held in New York early in November among representatives of the world's largest producers, said that the action taken by each member would be voluntary, and the reduction, expected to amount to 20,000 tons a month, would continue only during the existing period of congestion. The recommendation, it was pointed out, did not violate the law and there was no price-fixing agreement.

"Production, which in 1929 was stimulated to meet the peak demand of that year, has continued at a level higher than consumptive demand under the existing conditions of world-wide depression," the institute's announcement states. "The result has been the constant accumulation of stocks beyond any possibility of being liquidated under current conditions.

"Due to this fact and to the unforeseen falling off in demand due to the present industrial depression, the price of the metal has declined until it has reached a point below the average cost of production. The industry must face the fact of the necessity of curtailment of production. This curtailment can come in only one of two ways, either by the inevitable total suspension of many of the higher cost units, causing unemployment at mines, mills and reduction works, with resultant distress in communities throughout the mining section of the United States, or by the orderly reduction by the various units of the industry. It is hoped that by pursuing the latter method there will be brought about an equalization of current production to the consumptive demand without further addition to the already burdensome stocks that are jeopardizing the industry.

"The facts are as follows: On January 1, 1929, by way of comparison, the total stocks of refined copper, as reported by the American Bureau of Metal Statistics, amounted to 65,466 short tons. On January 1, 1930, this stock has been increased to 171,320 tons. On November 1, 1930, the latest date at which stocks are reported by the same authority, the total amounted to 364,930 tons, indicating a current excess production throughout the year of approximately 20,000 tons of copper a month.

"Of the present world's output of copper about 60 percent is produced outside the United States and about 40 percent within the United States.

"After a survey of the entire situation, the Copper Institute adopted a recommendation to the industry, urging that in its interest and in the interest of all dependent upon for employment and subsistence as well as of the public, so long as the present condition continues, such a reduction be made in current production as will prevent the increase of the existing stock.

"The present situation in the industry, together with all its surrounding facts and circumstances have been fully presented to counsel.

"We have been advised that the recommendation of the institute is not violative of the law for the reasons that the present production is in excess of normal and reasonable market requirements with resultant creation of excess stocks and that there is no price-fixing agreement. That the reduction made by each individual member is purely voluntary and entirely without coercion or compulsion, that in view of the abnormal surplus stock now on hand and of the fact that the recommended reduction will not materially reduce that surplus, that present stocks plus the suggested production are more than ample to satisfy any possible demand, and that the reduction is to operate only during the existing condition, and is entered into and confined in good faith to the purpose of meeting the present business disaster and depression."

Saunders Medal Awarded to D. C. Jackling

The 1930 William Lawrence Saunders Gold Medal was presented to Daniel C. Jackling, of San Francisco, president of the Utah Copper Company, at a dinner Friday night, October 31, at the Ritz Carlton Hotel in New York, which was attended by 250 leading mining engineers and executives from all parts of the world, some having come as far as Belgium and British Columbia.

The Saunders Medal is awarded annually by the American Institute of Mining and Metallurgical Engineers for "achievement in mining." It was presented to President Hoover in 1928.

Among those present at the dinner were many outstanding figures in the American mining, industrial and financial world. The guests included Charles M. Schwab, Bernard M. Baruch, Newcomb Carlton, president of the Western Union Telegraph Company; Stephen Birch, John D. Ryan, William Loeb, Jr., R. L. Agassiz, Edward E. Loomis, Clinton H. Crane, Walter Douglas, Dr. H. Foster Bain, Charles Bocking, and F. Pisart and Camelle Gutt.

Mr. Jackling is distinguished in mining circles for his scientific work in developing low-grade copper ores, an achievement which is said to have resulted in making the Utah district one of the great copper-producing regions of the world.

John Hays Hammond, holder of the 1929 Saunders Medal, was toastmaster at the dinner. Others at the speakers' table were Mr. Carlton; William H. Bassett, president of the American Institute of Mining and Metallurgical Engineers, who made the presentation address; Lafayette Hanchett, president of the Utah Power and Light Company; W. S. Boyd, of the Nevada Consolidated Copper Company; and Pope Yeatman, of Philadelphia.

Mr. Boyd in his address recounted the early struggles of Mr. Jackling who, in his young engineering days, had foreseen the possibilities of making low-grade copper ores profitable, but whose views have been met with scorn by the mining experts of 30 years ago.

Mr. Boyd said that it was almost entirely due to the engineering genius and organizing ability of this year's Saunders medalist that the copper produced in the Utah district was so great that last year's production represented about 27 percent of that mined in the United States and over 13 percent of world production. Mr. Boyd announced that at the end of the last year Utah and Nevada mining properties have produced since the beginning of operations a total of 349,000,000 tons of ore, which yielded $1,133,000,000 worth of copper and $44,-

United Verde Extension Options Vulture Gold Mine

The United Verde Extension Mining Company has obtained an option on the famous Vulture mine, at one time the greatest gold producer in the Southwest, 11 miles from Wickenburg, Ariz.

Verde Extension officials said work will begin immediately on a three-compartment shaft, which will be sunk to a depth of 500 feet in an effort to strike a faulted section of the old vein.

Recent diamond drill holes, sunk on the property to a depth of 400 ft., revealed what United Verde Extension officers said was "mighty good ore."

The Vulture mine was discovered in 1863 by Henry Wickenburg from whom the town on the Hassayampa River is named.

For the last three years surface operations have been conducted by D. R. Finlayson, who negotiated the deal with the United Verde.

Bradley Interests Acquire Imperial Gold Mines

Control of the Imperial Gold Mines Corporation, owning the Independence gold property near Copper Canyon, 14 miles southwest of Battle Mountain, Nev., has been taken over by the F. W. Bradley interests of San Francisco and a contract has been let to Charles W. Birum, former owner of the claims, to drive a 200-ft. tunnel below the present workings.

Under the terms of transfer to the Bradley interests the latter takes over a majority stock interest in the Imperial Company, which has authorized capital of $2,000,000 in shares of $1 par value.

It is stated that the Bradley management will proceed with operations on a scale that will depend upon the results obtained in development.

Phelps Dodge Branches Make Good Safety Record in October

Continuing the high efficiency record of the preceding month, the five branches of the Phelps Dodge Corporation turned in a safety report of only six lost-time accidents during October.

The Moctezuma and Morenci branches tied with perfect records for the month to lead the contest.

Four of the six time-lost accidents for the 31-day period occurred at the Old Dominion branch of the corporation in Globe; all six time-lost accidents occurred in the underground mining department with all other divisions—crushing, concentrating, smelting, mechanical, power and all shops, miscellaneous surface and all other departments division—showing a perfect score.

The Copper Queen branch was in second place for the month, with one time-lost accident, and the Stag Canon unit third, with one; the Old Dominion trailing the group, with four.

Thus far in the safety contest for the year to date 79 time-lost accidents have occurred at all branches.

Figured on a percentage basis, on the basis of 1,000 shifts worked, the Morenci branch is leading the contest for the year to date with 10 time-lost accidents, a percentage of .029; the Cooper Queen branch with 26 time-lost accidents and the Moctezuma with 18 are tied for second place for the year to date with a percentage of .044. The Old Dominion is third with a rating of .058 and the Stag Canon fourth.

North Butte Receivership Ended

The three-year legal fight among stockholders of the North Butte Mining Company was ended November 20, when Federal Judge W. A. Cant, at Duluth, Minn., dismissed receivers of the concern and formally completed the case.

Receivership action was instituted by Francis H. Hardy, a stockholder, who alleged the company was unable to meet its obligations, although its assets exceeded its liabilities. He asked the court to appoint a receiver for protection of stockholders. Hardy, at the time he petitioned for a receivership, had a claim against the North Butte for $6,500, for which he held $25,000 North Butte bonds as security.

The property of the North Butte, at the time the receivership was granted, was valued at $8,500,000.

Without sale of its tangible assets the North Butte, while still in the hands of the receivers, was able to pay off $357,374 of its outstanding debts and to raise $737,000 additional to meet the remainder of its obligations, which then amounted to $400,000.

Seven Tri-State Plants Work Ten Months Without Accident

Employes at four mines and three retreatment plants have worked through the first 10 months of 1930 without a lost-time accident, according to records of the accident prevention department of the Tri-State Zinc and Lead Ore Producers' Association.

The properties and owners follow:

Foch float plant of the Canam Metals Corporation; Scammon Hill, West Side and Wilbur mines of the Commerce Mining and Royalty Company; Bendelari mine of the Eagle-Picher Mining and Smelting Company; Dayton tailing mill of the Missouri-Kansas Zinc Corporation; No. 3 tailing mill of the St. Louis Smelting and Refining Company.

Twenty-nine mines and eight retreatment plants worked throughout October without suffering a lost-time accident.

Butte Copper & Zinc Co. Reopens Manganese Mine

Butte Copper & Zinc Company has reopened its Emma mine in the Butte district and is producing about 2,000 tons of manganese ore per month. This ore is being shipped in its crude state to eastern steel furnaces.

Tennessee Corporation

Adolph Lewisohn, president of the Tennessee Copper and Chemical Corporation, said that directors had deemed it to the best interests of the company to change the name to Tennessee Corporation, which would be more suitable in view of the present scope of the company's business and more consistent with the gradual broadening of its activities as favorable opportunity presents. A special meeting of stockholders has been called for December 2 to act on the proposal.

MANGANESE PRODUCERS MEET—SEEK EMBARGO ON RUSSIAN IMPORTS

The effect of Russia's "five-year" program upon the manganese industry in this country, and the alleged "dumping" of Russian manganese were topics which dominated the general discussions at the third annual convention of the American Manganese Producers' Association, held in Washington, November 10 and 11, resulting in the filing of a petition with the Treasury Department for an embargo against imports from Russia.

The manganese producers' brief says "irrefutable evidence of the dumping in this country of manganese ore by the Soviet Government" has been presented by the association, and that "fearless enforcement of the antidumping act" will assist in solving the Russian problem, which is declared to be "one of the most important facing the world today."

"The testimony is uncontradicted and unquestioned," says the brief. "It is so overwhelming and irrebuttable that it stands as an admitted and conceded fact that the American manganese industry, as a consequence of Soviet activities, has been seriously injured." The steel industry is charged with efforts to "stifle and throttle the development and production of domestic manganese."

In a message to the convention, Senator Oddie, of Nevada, announced that when Congress meets in December he will introduce a bill to forbid the entry of all products from Russia because they are being sold here at less than the pro-

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duction cost to the injury of American industries.

J. Carson Adkerson, president of the association, stated that improved methods of beneficiation of manganese ore had been developed, largely in wet concentration, furnace concentration, magnetic separation, flotation and leaching. He said, however, that the dumping of ore from Russia had paralyzed the American manganese industry, suspending plant operation and construction because of lack of market. He urged Government protection against imports of the Russian ore. He said the industry is capable of producing 1,200,000 tons of low-grade and from 400,000 to 800,000 tons of high-grade ore, which alone would yield railroads a freight revenue of from $6,000,000 to $10,000,000. He estimated that the manganese resources of the country, including from 200,000,000 to 400,000,000 tons of low-grade ore, would last for from 50 to 100 years. Mr. Adkerson stated that it costs $23.75 to deliver a ton of manganese ore from Russia to Atlantic ports in the United States, without the tariff duty, and that this ore is sold at $12.50 per ton in order to break down the American industry.

"Give the American producers sufficient encouragement in price and market, and the future requirements of the steel industry in time of peace will be amply provided for," said William B. Daly, manager of mines, of the Anaconda Copper Mining Company.

He stated that the manganese operations of the Anaconda company are at a standstill because of the business depression, the dumping of Russian ore into this country at prices below the ability of American producers to meet, and to the inability to obtain orders from the steel industry at a profit. With a price of 68 cents per unit, Mr. Daly said the mines in the Butte district in Montana could within three months furnish a very large part of the manganese requirements of the country. "The successful flotation of the low-grade and high-silica manganese ores in Butte has more than quadrupled the known manganese ore reserves in that district, and the possibility of developing larger tonnages in adjacent territory are promising," said Mr. Daly.

The present officers, including J. Carson Adkerson, president, were reelected, and the following new officers were chosen: Chairman of the board, James W. Gerard, of New York, former Ambassador to Germany; second vice president, William B. Daly, manager of mines of the Anaconda Copper Mining Company; third vice president, Leslie L. Savage, president, U. & S. Mining and Development Company; director, C. K. Woodbridge, president, American Machine and Metals Company.

New Ball Mill Discoveries to be Outlined at A. I. M. E. Meeting

New discoveries which are expected to double the capacity and greatly increase the efficiency of ball mills used the world over in the mining industry will be announced in February at the annual meeting of the American Institute of Mining and Metallurgical Engineers at New York City by Prof. A. W. Fahrenwald, of the University of Idaho School of Mines, codiscovered of the processes with Harold E. Lee, one of his assistants on the research staff of the Idaho Bureau of Mines and Geology.

This contribution undoubtedly will prove one of the greatest of all time to the mining industry, making possible savings in fine grinding of millions of dollars a year. Two years of study on the interrelated factors connected with ball milling resulted in a combination of those factors which make the savings possible without changes in design of the present type of ball mills.

Details of the new practices have been prepared by Prof. Fahrenwald and Mr. Lee in a technical paper which will be read at the Institute meeting in New York.

The ordinary ball mill in operation looks much like a barrel with steel balls rolling around inside of it. Roughly crushed ore is fed into the mill and the product often is ground so fine that, mixed with water, it looks like flour paste. Costs of ball milling range, roughly, from 10 to 35 cents a ton. Practically all ore mined goes through a ball mill, so generally are they used. With millions of tons of ore being ground each year, doubling the capacity therefore will effect huge savings, and the increased efficiencies possible will make the economics even greater.

I. C. C. Officials Visit Tri-State Field

Commissioner Joseph B. Eastman and Examiners J. G. Copper and Frank E. Mullen, of the Interstate Commerce Commission, were conducted over the Tri-State mining field to show conditions in the mining industry preparatory to a zinc and lead rate hearing held in St. Louis on Thursday. Accompanying the officials were 13 representatives of mining and smelting companies.

Butte & Superior Closes Black Rock Mine

The Butte & Superior Mining Company is suspending operations in its Black Rock mine at Butte, Mont., due to the depressed condition of the zinc market. The company has been gradually curtailing its operations since the first of the year, and at the present time but a small force of men is employed at the mine.

The Butte and Superior property is the last of the Butte zinc producers to shut down, other zinc properties having been non-operative for a year or more.

Employes Operating Waco Properties in Tri-State

Employes of the Missouri-Kansas Zinc Corporation have made a profit-sharing agreement with C. Erb Wuensch, ancillary receiver of the Missouri-Kansas company, whereby the mines in the Waco district of Missouri will be continued in operation.

Wuensch decided to close the mines following the decline in concentrate prices, and would have closed but for the proffer of the employes.

American Zinc—Federal Transaction Clarified

In our November issue it was reported that the Federal Mining & Smelting Company had purchased from the American Zinc, Lead & Smelting Company for less than $400,000, acreage for which the American Company had paid $7,500,000, reserving only a lead smelter at Granby, Mo. An official of the American Company advises that the original purchase of his company consisted of some lands and mines, a lead smelter, and two zinc smelters, one of which is the East St. Louis smelter. The recent sale to the Federal consisted of lands which the latter had had under lease for some time.

Odor is Warning Agent in Fire Fighting Standards Just Approved

A disagreeable odor, shot through ventilation lines, will be used to warn miners of fire in all metal mines complying with the provisions of the American Standard code for fire fighting in metal mines. The standard has just been approved by the American Standards Association following its submittal by the National Fire Protection Association and the American Mining Congress, sponsors for the joint technical committee which has been working on the standard under American Standards Association auspices since early in 1925.

Provision is made in the standard for measures to be taken for the prevention of fires, fire fighting equipment, fire fighting personnel, and warnings of fires.

In addition to the use of a disagreeable odor as a warning signal, the standard also provides that in mines equipped with electric lights the engineers shall also flash all electric lights nine times in three series of three flashes each. Since trouble may develop in the

electrical system, however, the odor signal is considered to be the more reliable warning.

While pleasant odors have been experimented with, disagreeable odors have been found preferable because of the more positive effect which they exert. The United States Bureau of Mines, which played an important part in the establishment of the standard, found that when miners smell the disagreeable odors used, they instinctively desire to obtain pure air at once. If the miners are unable to reach the surface for any reason, however, it has been found that they are able to tolerate the odors without much discomfort.

The odors are injected in liquid form into the compressed air line supplying air to the mines. The air in these lines moves at the rate of from several hundred to several thousand feet per minute. Little liquid is required, the odors being detectable at concentrations of only a few parts per million parts of air. At higher concentrations the odor becomes strong enough to make the warning positive. None of the odors used can exert any harmful influence even if inhaled for a long period. Some of the odor-producing substances used are known technically as butyl mercaptan, ethyl mercaptan, butyric acid (odor of rancid butter) and amyl acetate (banana oil).

Among the organizations which cooperated in the preparation of the standard, in addition to the American Mining Congress and the National Fire Protection Association are: The United States Bureau of Mines, the American Institute of Mining and Metallurgical Engineers, the National Board of Fire Underwriters, the National Safety Council, the American Association for Labor Legislation, the National Electrical Manufacturers Association, the Railway Fire Protection Association, the Fire Equipment Institute, and the Rubber Association of America.

William Conibear, of the American Mining Congress, is chairman of the technical committee.

New Head of Bureau of Mines Petroleum Division

E. B. Swanson has been appointed chief economist of the Division of Petroleum Economics of the Bureau of Mines. Mr. Swanson has been serving as acting chief of the division since October, 1928. He is a graduate of the University of Washington.

The Petroleum Economics Division was established as a unit in the Economics Branch of the Bureau of Mines on January 1, 1926. Future work of the Petroleum Economics Division will include additional studies of the distribution and utilization of petroleum products.

Mine Depletion Hearing December 9

The Joint Congressional Committee on Internal Revenue Taxation has definitely fixed December 9, at 10 a. m., as the time for a hearing on the mine depletion allowance question. The hearing will be held in the hearing room of the House Committee on Ways and Means in the House Office Building and will center around the proposed percentage depletion method. The committee is expected to receive the views of the Treasury Department as well as those of the mining industry.

Consolidated Coppermines Will Appeal Case

An appeal from the decision of Judge Frank N. Norcross in the suit of the Nevada Consolidated Copper Company against the Consolidated Coppermines Company in which the latter was restrained from mining in such claims adjacent to the Liberty pit of the plaintiff as would interfere with the pit or its operations, has been taken by Consolidated Coppermines.

Petition for the appeal was fined in the Federal court at Carson, according to form prescribed in the Federal court and from this petition the appeal is to be taken to the Circuit Court of the Ninth Circuit.

Oil Shale Reduction Plant Projected in Nevada

Frank Catlin, one of the executives of the Catlin Shale Products Company, of Trenton, N. J., states that in approximately three years, or earlier, dependent on improved market conditions, a large reduction plant will be constructed at Catlin, Nev.

For a period of five years the Catlin interests experimented with the shale beds near Elko, Nev., at an expense of nearly a million dollars. These experiments are said to have developed satisfactory information to the Catlin Company, which has wrecked the old plant.

Mr. Catlin declared that statements that the experiments at Catlin had been unsuccessful are untrue and that the recovery of high-grade lubricating oil on a very big scale, together with a great school of chemicals and commercial products, may be done on a successful commercial basis.

New Book of Motor and Generator Standards

Anyone concerned with the selection, installation and operation of motors and generators will be interested in the new book of motor and generator standards just published by the National Electrical Manufacturers Association. This book contains much valuable reference information on application and selection, ratings, tests, performance, construction, guarantees and business policies, also comprehensive lists of definitions and abbreviations of terms pertaining to motors and generators.

The material includes motors, generators, frequency converters and motors over 60 cycles for industrial purposes, large synchronous motor-generators, elevator motors, a-c crane motors, synchronous compressor motors, d-c planer motors, d-c motors for machine tool and similar applications, d-c adjustable speed motors, d-c motors for direct connection to centrifugal fans, and farm-lighting generators.

This volume is a development of years of standardization work by the association and its predecessors, which has for its object promotion of uniformity in engineering and manufacturing practice, production economies and improved quality of electrical apparatus, all of which are of advantage to both producer and user.

The book contains 132 pages, 8 by 10½ in. in size and is bound in heavy brown linen covers. It may be obtained from National Electrical Manufacturers Association at 420 Lexington Avenue, New York, N. Y., at $1.50 per copy.

Motion Picture Film Depicts Manufacture of Refractories

The Harbison-Walker Refractories Company, world's largest producer of refractories, Pittsburgh, Pa., have just completed a 5,000-ft. motion picture illustrating modern methods employed in the manufacture of refractories. The film shows every step in the production of refractories from the mining of raw materials to the loading and shipping of the finished product. Scenes in the research and control laboratories and some interesting animated photography showing the action of periodic and continuous tunnel kilns are also included in the picture.

This Harbison-Walker film, perhaps the most complete story of refractories ever made for the screen is available, without cost, to technical societies, engineering organizations, industrial organizations, universities, colleges, technical schools and research laboratories. It is suggested that early applications be made to Harbison-Walker Refractories Company, 1800 Farmers Bank Building, Pittsburgh, Pa.

Gasoline Taxes

The 48 states and the District of Columbia collected $431,636,454 in taxes on the sale of 13,400,180,062 gallons of motor fuel in 1929, according to the Department of Agriculture. The average fee per gallon was 3.22 cents, as against 3 cents in 1928. The highest tax per gallon was 6 cents; the lowest 2 cents.

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Coal Analysis Standards Approved

The American Standards Association has approved American Standard methods of laboratory sampling and analysis of coal and coke submitted by the American Society for Testing Materials. These methods were originally prepared by joint committees of the American Society for Testing Materials, American Chemical Society, and the American Foundrymen's Association. They were adopted by the American Society for Testing Materials in 1916 and 1918, and were revised in 1921, 1924, 1927, 1929, and 1930 by the Committee on Coal and Coke of the American Society for Testing Materials.

The recent revisions of the methods consist of minor changes in some of the methods of test and do not radically alter any of the procedures. These changes are the result of investigations of the methods of analysis with a view of increasing their accuracy. Many of the determinations made in analyzing coal and coke are in part empirical in nature and methods of this character require close standardization to secure good agreement between different laboratories.

The standards just adopted are generally recognized and used by most of the large consumers of coal in the United States. The methods are extensively used in purchasing coal under specifications for power production. They are also used by large coal producers who process their coal before marketing to improve its quality, and are in general use for evaluating coals for gas and coke plants. The methods of coke analysis are principally used for evaluating coke for metallurgical purposes. The acceptance of the methods by the American Standards Association will broaden their recognition and use in this country.

College Men Visit Anthracite Laboratory

Exceptional interest was displayed by college men representing the engineering departments of 21 institutions in the eastern part of the country, who on November 1, at the invitation of Noah H. Swayne, executive director of the Anthracite Institute, visited the research laboratory of that institution at Primos, Pa. The party was in charge of Allen J. Johnson, director of the laboratory, and C. A. Connell, director of the Anthracite Coal Service. All devices which are at this time under test, among which were automatic stokers, magazine feed boilers, service water heaters, blowers, thermostatic control and ash removal systems, were thoroughly explained. Special interest was manifested in the system of removing ashes from pit through hose to tank on truck, thus eliminating ash handling and its consequent dust, as well as in many of the mechanical stokers under test.

The party was entertained at luncheon in Philadelphia by Mr. Swayne, who explained in detail the functions of his organization and what was being done not only to further the use of anthracite as a fuel, but the broader field in which greater accomplishments might be looked forward to by the industry. Mr. Swayne called attention to the work which is being done in the engineering departments of Yale, Penn State and Lehigh Universities in the line of research concerning anthracite as well as the commendable work of the Anthracite Coal Service engineers in their efforts to solve heating problems in individual plants and homes, and also the assistance given to the retail dealers in solving their own individual complaints.

The object of the inspection trip was to familiarize the institutions represented with the problems confronting the anthracite industry and the method by which they are being handled with a view to bringing forth some useful suggestions along the lines of research from sources outside of the lines of regular endeavor.

Third International Coal Conference at Carnegie in November, 1931

A third international conference on bituminous coal will be held at the Carnegie Institute of Technology at Pittsburgh in November, 1931, according to a recent announcement made by Dr. Thomas S. Baker, president of the Institute of Technology and organizer of the first two international congresses.

An invitation will be extended to scientists of all countries to take part in the meeting, which is the only one of its kind of international scope. Prominent men of affairs in America will assist Dr. Baker in organizing the meeting.

The purpose of the congress, President Baker announced, will be similar to that of the meetings held in 1926 and 1928—to present for discussion the results of recent studies of coal. Particular attention will be paid to the economics of the new methods and processes that are being evolved, he indicated.

The program will include papers on carbonization, liquefaction and gasification of coal; by-products of coal; the mechanism of combustions; cleaning of coal and its preparation for the market; pulverized fuels; power plants; and domestic heating. The discussions will be confined to coal above ground. Beginning at the mouth of the mine, however, practically every phase of distribution and consumption will be treated by outstanding authorities in the several fields.

"The condition of the coal industry during the past few years can hardly be called healthy," President Baker said, "and the current business let down has brought extreme depression to this basic world industry. We hope that, as a result of the discussions held, we may be of assistance in uncovering new processes which may help it on the road to recovery."

Announcement of this third world meeting comes in logical sequence to the previous congresses. The first conference was organized by President Baker in 1926 for the purpose of finding new uses for bituminous coal and especially to discuss the problem of liquefying coal to supplement the petroleum oil supply of the world. This meeting, although it was the first of its kind to be held, attracted 1,700 scientists from 13 different countries. Two years later followed the second congress, which was broader in its scope, including discussions on pulverized fuel, low temperature carbonization of coal, rubber from coal, the hydrogenation of coal, and by-product nitrogen. Speakers during the two conferences have included such scientists as Georges Claude, Dr. Friedrich Bergius, Prof. Franz Fischer, Dr. C. H. Lander, Dr. R. Lessing, Gen. Georges Patart, Dr. Fritz Hofmann, and Dr. Karl Krauch. Papers of numerous other fuel technologists were presented at the meetings.

The published proceedings of the two conferences have been enthusiastically received, and they are now considered standard reference books on modern fuel technology.

C. M. Moore Heads Southern Appalachian Coal Operators' Association

The annual meeting of the Southern Appalachian Coal Operators' Association was held in Knoxville, Tenn., November 21. C. M. Moore, president of the Moore Coal Company, Knoxville, was elected president; R. S. Young, secretary-treasurer, Blue Diamond Coal Company, Knoxville, first vice president; and C. W. Rhodes, vice president and general manager, Fork Ridge Coal & Coke Co., Middlesboro, Ky., second vice president. R. E. Howe was reelected secretary-treasurer. Directors elected were: V. N. Hacker, John L. Boyd, Alex Bonnyman, E. C. Mahan, C. W. Henderson, and W. G. Polk, all of Knoxville; J. E. Butler, Stearns, Ky.; J. B. Gatliff, Williamsburg, Ky.; S. M. Reams, Middlesboro, Ky.; C. Hoyt Bradford, Stanlee Hampton, and Dr. W. B. Young, of Nashville. The silver loving cup offered last year by

the Provident Life and Accident Insurance Company, of Chattanooga, Tenn., to the company in the association making the greatest improvement in personal injuries during the year ended September 30, 1930, compared with the year ended September 30, 1929, was awarded to the Premier Coal Company, Middlesboro, Ky., and presented at the meeting.

D. B. Cornett Reelected President Harlan County Coal Operators' Association

At a meeting of the Harlan County Coal Operators' Association, held November 21 at Harlan, Ky., the following officers were reelected: President, D. B. Cornett, president, Cornett-Lewis Coal Company, Louisville, Ky., and vice president, S. J. Dickenson, Mary Helen Coal Corporation, Coalgood, Ky. All members of the board of directors were also reelected, with the exception of J. C. Stras, president, Kentucky Cardinal Coal Corporation, Cardinal, Ky., who was succeeded by A. F. Whitfield, Sr., president, Clover Fork Coal Co., Kitts, Ky. Presentation of eight silver cups was made to Mr. Cornett by Mr. Whitfield for his loyal service in the furtherance of the association's interests. E. R. Clayton was reelected secretary and treasurer.

At a meeting of the Harlan Coal Bureau, which immediately followed the operators' meeting, R. C. Tway, president, R. C. Tway Coal Co., Louisville, Ky., was reelected president and W. J. Cunningham, president, Crummies Creek Coal Co., Crummies, Ky., vice president, in place of D. B. Cornett. Members of the board of governors were reelected, with the exception of B. W. Whitfield, president, Harlan Collieries Co., Brookside, Ky., who was succeeded by A. F. Whitfield, Jr., Clover Fork Coal Co., Kitts, Ky. Every member of the bureau expressed belief that the work of the bureau had been most beneficial to the Harlan industry. E. R. Clayton was reelected commissioner.

More than 100 persons, including operating and business officials, attended the second annual banquet of the Harlan County Mining Institute, held in the evening.

Anthracite Shipments—October

Shipments of anthracite for the month of October, 1930, as reported to the Anthracite Bureau of Information, Philadelphia, amounted to 6,177,851 gross tons. This is an increase as compared with shipments during the preceding month of 2,278,446 tons, and when compared with the month of October, 1929, shows a decrease of 299,878 tons.

Illinois Mining Institute Holds Annual Meeting at Centralia

The Illinois Mining Institute held its thirty-ninth annual meeting at Centralia, Ill., on October 31, with the largest attendance seen in recent years.

At the business session, M. M. Leighton, of the State Geological Survey at Urbana, Ill., presented a proposal for the extension of the State Geological Survey and the Institute unanimously passed a resolution in favor of it. Another resolution was adopted favoring vocational education for coal miners, and committees will be appointed to follow this movement throughout the State, with the necessary expenditures and support of the institutions connected therewith.

Paper presented to the meeting were as follows:

C. B. Smith, chemical engineer, of the Dearborn Chemical Company, Chicago, on "Protecting Iron and Steel Against Corrosion."

J. Paul Clayton, vice president of the Central Illinois Public Service Company, at Springfield, on "Purchased Power Used in Coal Mine Operation."

Capt. E. S. Steidle, dean of School of Mining Industry, Pennsylvania State College, on "Vocational Education."

W. D. Langtry, president of Commercial Testing and Engineering Company, Chicago, on "Utilization of Coal."

At the banquet in the evening, Warren E. Fuller, assistant to the executive vice president of the C. B. & Q. R. R., was the guest of honor and spoke on the problems of the railroads and the coal industry, illustrating in very good fashion how the interests of both were interlocked, and how they should work together to solve many things they have in common.

The Chamber of Commerce of Centralia cooperated with the Institute in making the meeting a successful one. The high school and city school bands entertained both at noon and afternoon session.

The Institute has grown in the past year; the membership increased approximately 150 percent during 1930.

The Institute secured a block of tickets for the Purdue-Illinois football game on November 1, and a large part of the attendance motored to Champaign and witnessed the game.

It was voted at the meeting to have the next semiannual meeting aboard some boat on the Mississippi River.

The following officers and executive board were elected for the ensuing year:

President, Jos. D. Zook, president and commissioner of the Ilinois Coal Operators' Labor Association.

Vice President, George C. McFadden, assistant vice president of Peabody Coal Company.

Secretary-Treasurer, B. E. Schothal, president, B. E. Schonthal and Company, Inc.

Executive Board, Prof. A. C. Callen, Mining Department, University of Illinois; John A. Garcia, Allen & Garcia Company; Carl T. Hayden, general manager, O'Gara Coal Company; J. A. Jefferis, Illinois Terminal Railroad System; W. J. Jenkins, president of Consolidated Coal Company of St. Louis; John E. Jones, safety engineer, Old Ben Coal Corporation; John G. Millhouse, director of mines and minerals, State of Illinois; Harry Moses, superintendent, U. S. Fuel Company; Chas. F. Hamilton, vice president, Pyramid Coal Company; F. S. Pfahler, vice president, Superior Coal Company; H. A. Treadwell, general superintendent, Chicago, Wilmington & Franklin Coal Company; Paul Weir, vice president, Bell & Zoller Coal Company.

Lake Cargo Rates Evidence All In

Evidence winding up the latest contest over lake cargo coal rates was presented at an Interstate Commerce Commission hearing at Washington November 12 as a sequel to other testimony received at similar hearings at Chicago and Washington.

Representatives of Ohio and Pennsylvania mine operators seeking to obtain an increase of the 35-cent per ton differential now in effect between their rates and those for Tennessee, Kentucky and West Virginia producers were the only ones heard.

Aided by statistical charts and tables A. B. McElvany, secretary of the Western Pennsylvania Coal Traffic Bureau, argued that the southern mines ought to pay an increased differential. He said these operators in 1929 were able to market 50,000,000 tons of coal in the industrial East outside of the lake cargo traffic and to pay on it a differential 55 cents per ton greater than the rates to the same market from Ohio and Pennsylvania.

This was challenged by attorneys for the southern operators in protracted cross-examination.

Arkansas-Oklahoma Coal Operators To Maintain Existing Wage Scale

Miners in Arkansas and Oklahoma need have no fear that their wage scale will be cut, J. G. Puterbaugh, president of the Arkansas-Oklahoma Coal Institute, said following the annual meeting of the institute at Fort Smith, Ark., November 5.

The operators decided to maintain the present wage scale and discourage lowering of the scale by non-members of the institute, despite business depression, Puterbaugh said.

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COMMERCIAL STOCKS OF ANTHRACITE AND BITUMINOUS COAL, OCTOBER 1

Bituminous coal.—Consumers' stocks of bituminous coal were increased during the third quarter of 1930, and on October 1 amounted to 35,900,000 tons, according to the Bureau of Mines. On July 1, the date of the last survey, there were 32,200,000 tons in storage. During July there was an increase of 900,000 tons, making a total of 33,100,000 tons on hand by August 1. From August 1 to October 1 stocks were still further increased by 2,800,000 tons. Thus the total accumulation between July 1 and October 1 was 3,700,000 tons.

Although the stocks on October 1 were greater than at the beginning of the previous quarter, this increase is largely seasonal, since stocks often increase with the approach of the heating season as consumers prepare for cold weather. In comparison with the tonnage in storage on the same date last year, the present stocks show a decrease of 1,600,000 tons. This decrease is in part offset by the lower current rate of home consumption in comparison with 1929.

Consumption during the third quarter of the year averaged 7,370,000 tons a week. Exports averaged 382,000 tons a week and the total consumption plus exports was 7,752,000 tons a week. When compared with the corresponding period of last year, the rate of home consumption shows a decrease of 15.4 percent. In this connection, it should be remembered that the rate of coal consumption increases rapidly with colder weather in the fall and winter months. Last year, for example, the rate of consumption rose from an average of 8,713,000 tons in the third quarter to 10,782,000 tons in November and December, a gain of 23.7 percent.

Stocks by Classes of Consumers

At the rate of consumption prevailing in August and September, the stocks on October 1 were sufficient to last 35 days, if evenly divided. Stocks are rarely evenly distributed, however, and there were wide variations in the reserves of individual consumers. The largest reserves on October 1 were held by the coal gas plants, with 68 days' supply. Details for other classes of consumers are given below. In spite of the fact that the actual quantity of coal held by most classes of consumers on October 1 was less than on the corresponding date of last year, it will be noted that each group reported an increase in terms of days' supply, due to the lower rate of consumption prevailing during the period under review.

By-product coke and steel works.—Stocks at by-product plants have increased somewhat during the last three months, while the steel works report a slight decline. Complete returns from the by-product plants show a total of 5,522,655 tons of coking coal in storage on October 1, of which 1,656,531 tons was low volatile and 3,866,124 tons was high volatile. At the steel works and rolling mills 555,035 tons of steam coal and 496,155 tons of gas coal were on hand October 1, a total of 1,051,190 tons.

Railroad fuel.—According to the American Railway Association, stocks of railway coal on October 1 amounted to 6,145,000 tons. In comparison with the quantity on hand three months ago, this is an increase of 498,000 tons, but it is less than the tonnage held by the railroads on comparable dates in other recent years.

Increase in stocks in terms of days' supply.—Because of the unusually low rate of consumption in the third quarter of 1930, the stocks on October 1 in terms of days' supply were actually greater than on the same date last year, in spite of the fact that there has been a net reduction of 1,600,000 tons during the past 12 months. Each of the consuming groups, with the exception of the cement plants, had a supply equivalent to a greater number of days' requirements on October 1, 1930, than on the corresponding date of last year.

The reserves at general industrial plants (other than steel, coke and cement plants) illustrate the general trend. A year ago the average reserves for all industrial plants reporting were sufficient to last 35 days, while at present 39 days' supply is on hand. Each of the consuming districts shows an increase except New England, where a decrease occurred, and the lower Missouri Valley, where stocks remain at approximately the same level as a year ago. Similar conditions prevailed among other groups of consumers, except the cement plants whose reserves in most districts are less than on October 1 of last year.

DAYS SUPPLY OF BITUMINOUS COAL IN HANDS OF VARIOUS CLASSES OF CONSUMERS IN THE UNITED STATES, JANUARY 1, 1919, TO OCTOBER 1, 1930

	Jan. 1, 1919	Sept. 1, 1925	Oct. 1, 1926	Oct. 1, 1927	Oct. 1, 1928	Oct. 1 1929	July 1, 1930	Aug. 1, 1930*	Oct 1, 1930*
By-product coke plants.....	32	22	26	40	27	26	25	29	32
Steel plants	42	30	37	58	31	27	31	33	32
Other industrials	65	38	37	62	37	32	29	34	36
Coal-gas plants	81	67	70	93	72	64	61	66	68
Electric utilities	49	43	45	69	56	44	49†	47	50
Coal dealers (bituminous)..	39	27	32	43	33	35	51	36	44
Railroads	32	28	33	48	29	20	20	21	22
Total bituminous	42	32	35	53	35	30	31	32	35

* Calculated at average rate of consumption in August and September, 1930.
† Revised since last report.

Bituminous Coal in Transit

In addition to the reserves in the hands of consumers, there is always a considerable tonnage which has been produced but not yet delivered to a consumer, and which may be considered in transit.

The largest element in the quantity in transit is, of course, the coal moving in railroad cars, which has never been accurately measured but runs into many million tons.

The American Railway Association reports that on October 1 there was 1,504,000 tons of unbilled coal on wheels waiting shipment at the mines or in classification yards. In comparison with July 1, this is a decrease of 26,000 tons.

Mine storage.—The few bituminous operators who follow the practice of storing at the mines, or at intermediate points, reported a total of 251,000 tons on hand October 1, as compared with 194,000 tons on July 1, and 467,000 tons on October 1, last year.

Coal on the Upper Lake Docks.—By the first of October the tonnage held by the dock operators usually approaches a maximum. According to figures courteously furnished by the lake dock operators, a total of 9,803,696 tons was on hand at the head of the Lakes on October 1. This was somewhat less than the tonnage on hand last year when a total of 9,896,825 tons was reported.

Coal in retail yards.—Retail stocks of anthracite and bituminous coal show the usual seasonal increase. Since July 1, the date of the last survey, anthracite stocks have increased 12 percent. The present stocks are also somewhat higher than the quantity on hand on corresponding dates in other recent years. At the rate the householders were calling for anthracite in August and September, the stocks on October 1 were sufficient to last 61 days, as compared with 55 days supply on October 1, 1929.

It was not feasible to canvass all retailers, but information was obtained from a representative group of 876 dealers scattered throughout the country who are believed to be typical and whose replies have been summarized in the following table. Of these dealers there were 467 handling anthracite and 766 handling bituminous coal who have reported at every one of the stock surveys since 1919.

Stocks of bituminous coal in retail yards show an increase of 27.7 percent since July 1, and are also higher than they were on corresponding dates in 1929 and 1928, but are considerably

under those on October 1, 1927. At the rate of deliveries prevailing in August and September the stocks of bituminous coal in retail yards on October 1 were sufficient to last 44 days.

P. N. Guthrie Made Head of Reading Iron Co.

Following a special meeting of the directors of the Reading Iron Company in Philadelphia November 18, A. J. Maloney, chairman of the board, announced the election of P. N. Guthrie, Jr., as president of the Reading Iron Company. Mr. Guthrie has been serving as vice president in charge of sales. He succeeds Leon E. Thomas, who resigned the presidency on July 31 last. Since that time A. J. Maloney, as chairman of the board, has performed the executive duties of the president, which will now be turned over to Mr. Guthrie.

The Reading Iron Company is a wholly owned subsidary of the Philadelphia and Reading Coal and Iron Company.

DeBardeleben Coal Corp. Equips Novel Collier

The freighter *H. F. DeBardeleben*, owned by the DeBardeleben Coal Corporation, was recently converted to carry Alabama coal from the ports of Pensacola and Mobile, embodying several new features in ship construction. She is equipped to discharge a cargo of 7,500 tons in 10 hours, where the ordinary vessel would require 10 days.

She is the first American-owned self-discharging steamer operating in the Gulf of Mexico or the Atlantic or Pacific Ocean, and is the first steamer in the Gulf waters burning pulverized coal. She has 5 cargo holds and 12 hatches, and can carry 500 tons of package freight in addition to her major cargo of bulk commodities.

The ship is 380 ft. long, 53 ft. beam, 23.5 ft. draft, and is valued at $1,000,000. Two scraper tunnels and diagonal bilge tanks extend through all of her cargo holds, permitting the contents of coal, sulphur, gravel, slag, rock and ore to run automatically into the tunnels and thence, by a patented boom device, to be discharged ashore. The Bulk Company operates her for the DeBardeleben Coal Company as the first of a fleet of ships that will be built for the handling of Alabama coal.

Carnegie Coal Company Starts On New Basis

The Carnegie Coal Corporation, capitalized at $6,000,000, has taken over the coal holdings of the Carnegie Coal Company, which formerly was owned by John A. Bell, coal operator and banker, who was sentenced to prison several years ago as a result of the failure of the Carnegie Trust Company.

Twelve thousand acres of coal lands in Allegheny and Washington Counties, Pa., have been sold to the Manor Real Estate and Trust Company of Philadelphia for $1,000,000 to liquidate taxes and other debts of the reorganized coal company. Dock properties have been mortgaged for $750,000 to provide a working capital. This, it was said, is the only debt of the new company.

The Carnegie Coal Corporation has seven mines situated along the Panhandle Railroad in Allegheny and Washington Counties. It was stated that the concern already is producing at a rate of 1,200,000 tons annually and expects to increase the production to 2,000,000 tons a year.

Patrick J. Quealy Dies

Patrick J. Quealy, president of the Gunn-Quealy Coal Company and the Kemmerer Coal Company, died at his home in Kemmerer, Wyo., November 17. He was 73 years old and had been connected with the coal industry for 60 years. Mr. Quealy came to America from Ireland at the age of 9. In 1870 he worked in the mines of Missouri, and in 1875 he went to Wyoming where, with the exception of two short periods spent in British Columbia, Washington and Montana, he has since been actively engaged in the development of that field. He organized the Rock Springs Coal Company in the fall of 1887, being the pioneer private operator. Up to that date no one had undertaken to operate a mine in Wyoming except the Union Pacific. The Gunn-Quealy Coal Company was organized at Rock Springs, Wyo., in 1907. He was also prominent in the banking, timber and livestock industries of that section.

Both the nomination for the United States Senate and the House of Representatives had been tendered Mr. Quealy, but he declined the honor. The only public offic he would consent to hold was that of trustee at the University of Wyoming, and he was a member of the university board at the time of his death.

Large Merger of Coal Properties in Northern West Virginia

A merger of more than two score coal properties in northern West Virginia was announced at Charleston, W. Va., November 13, with the filing of an application for a charter for the Three Cities Fuel Corporation, which will have headquarters in Fairmont.

The new company, described by its organizers as "the result of a concerted move on the part of strong financial groups in the Monongahela Valley to stabilize the coal industry in northern West Virginia," will take over about 45 mining properties located in Harrison, Marion, Monongahela, Barbour and Taylor Counties and having an annual production of 5,000,000 tons.

Geo. M. Alexander, of Fairmont, has been selected to head the new corporation. Mr. Alexander is president of the Monongahela West Penn Public Service Company. Other officers are: Jas. R.

Broken Trolley Wire Held Cause of Sunday Creek Disaster

Above is shown a general view at the mouth of Mine No. 6 of the Sunday Creek Coal Company at Millfield, Ohio, where an explosion on November 5 took the lives of 82 miners and company officials, including W. E. Tytus, president of the company, and P. A. Coen, vice president.

According to the finding of E. W. Smith, chief of the State Department of Mines and Mining, the explosion was caused by a broken trolley wire which, falling on a steel rail, caused a long spark which set off a gas pocket. The trolley wire was broken by a fall of slate and occurred about 2,000 ft. from the main shaft substation where the inspection party, including the president and vice president, had just landed.

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Moreland, Morgantown attorney, vice president; C. E. Smith, secretary, and Louis A. Johnson, Clarksburg attorney, treasurer. The directors are: C. W. Watson, Fairmont, former U. S. Senator and former president of the Consolidation Coal Company; Geo. M. Alexander; J. H. Thomas, president of the National Bank of Fairmont; C. W. Green, executive vice president of the Union National Bank of Fairmont; H. C. Greer, Morgantown capitalist and publisher; James R. Moreland; Carl L. Horner, Clarksburg, mining engineer and coal operator; Louis A. Johnson, and George W. Fleming. The executive committee consists of C. W. Watson, Geo. M. Alexander, J. H. Thomas, H. C. Greer, and Carl L. Horner.

It is said that the company, capitalized at $2,500,000, would be operating very shortly. The next step toward stabilization of the coal industry in the Fairmont field, it was further stated, would be the organization of another corporation to absorb the larger production units. At the completion of the general plan it is believed that two-thirds of the annual production of the Monongahela Valley field would be under common ownership.

Correction

In the article by Mr. C. L. Lutton on "Protective Clothing in Accident Prevention Work," which appeared in our November Journal, part of a sentence relating to eye accident rates was inadvertently omitted. This passage should have read: "During the two-year period (1928-1929), the use of goggles having been thoroughly established, the eye injury rate experienced was 1.21 percent—a decrease of 76.73 percent in the disabling eye injury rate of 5.20 percent experienced in the years 1924-1925 before goggles were used."

Coal-Mine Fatalities in October

Reports received by the Bureau of Mines from State mine inspectors, covering fatal accidents at coal mines in the United States during October, showed a higher death rate per million tons of coal mined than was shown for either September of the present year or for October a year ago. The higher rate prevailed for the industry as a whole and for bituminous mines considered as a separate group, but the rate for anthracite mines, although higher than that for October a year ago, was lower than for September of the current year. The actual number of men killed in all coal mines in the United States in October, 1930, was 188, or 9 less than in October, 1929, but 48 more than in September, 1930.

Considering the bituminous mines in various States, a death rate of 3.24 was shown, based on 143 deaths and 44,150,000 tons of coal produced. This fatality rate indicated an increase of slightly over 21 percent as compared with September, 1930, whose record was 103 deaths and 38,632,000 tons, and an increase of about 11 percent over the rate for October, 1929, which was based on 153 fatalities and 52,174,000 tons of coal.

In the anthracite mines there were 45 deaths during October of the present year, and a production of 7,576,000 tons, thus indicating a fatality rate of 5.94, as compared with 37 deaths and a rate of 6.99 for September, 1930, when the output of coal was 5,293,000 tons.

During the period from January to October, 1930, there were 1,635 deaths in all coal mines in the United States, and during this period 442,301,000 tons of coal were mined; the record for the same 10 months last year showed 1,760 deaths and a production of 502,060,000 tons.

There was one major disaster—that is, a disaster in which five or more lives were lost—during October, 1930. This was an explosion at McAlester, Okla., on October 27, which caused the loss of 30 lives. October, 1929, was free from such disasters.

Bureau of Mines Gives Performance Tests for Trailing Cables

The Bureau of Mines has collected field data and made laboratory investigations of trailing-cable performance in the hope of developing a better and safer cable for use with permissible mining machines. Because of their better insulation and performance, only rubber-sheathed cables were finally considered. The cables tested represented the product of six manufacturers.

After consideration of the results of the preliminary investigations, the conditions under which cables are used in mines, and the better performance of the later types of cables that were submitted as the investigation progressed, the bureau formulated a performance-test requirement and notified the cable manufacturers as follows:

"The hazards of the trailing cable are such that the bureau has been unable to extend beyond the machine its formal approval to cover the cable as at present developed. However, in the attempt to reduce the hazard as much as possible, cables passing certain tests will be recommended for this service, and it is hoped that several cables will be developed to meet this requirement."

The test requirement follows:

"The cable will be placed across the two rails of a track and a four-wheeled 7-ton car will be run over it 50 times. The speed of the car shall be approximately 3½ miles per hour and potential shall be applied to the cable during tests. The cable will be shifted in position after each passage of the car, thus giving 100 places over which two wheels have passed. To warrant special recommendation of the bureau, a cable must neither become short-circuited nor grounded either to the rails or wheels at more than 10 percent of the 100 places."

A No. 2 parallel duplex "Hazacord" cable, manufactured by the Hazard Insulated Wire Works, Wilkes-Barre, Pa., has met the foregoing requirement, and will be included in the next semiannual list of permissible equipment as "No. BM-1 cable especially recommended for use with permissible mining machines."

Louis C. Madeira Dies

Louis C. Madeira, of Philadelphia, vice president of Madeira, Hill & Company, died October 31 after a brief illness in his seventy-eighth year. Mr. Madeira graduated from the University of Pennsylvania in 1872, following which he was employed for five years as a civil engineer by the Wilmington & Northern and the Bound Brook Railroad. He then joined the insurance firm of Louis C. Madeira & Sons, founded by his father, eventually becoming president of the concern. He later associated himself with Madeira, Hill & Co. In addition to serving as secretary and later as vice president of this firm, Mr. Madeira became secretary and a director of the George B. Newton Coal Company, treasurer of the Saltsburg Coal Mining Company, treasurer and director of the Thomas Colliery Company, and a director of the Standard Ice Company, Harleigh Brookwood Coal Company, Colonial Collieries, Saving Fund Society of Germantown, and several insurance companies.

Tracy W. Guthrie Dies

Tracy W. Guthrie, 62, former president of the Republic Iron and Steel Corporation and more recently president and vice president of the Hillman Coal and Coke Company, of Pittsburgh, died at his home in Sewickley, Pa., a Pittsburgh suburb, November 15.

Mr. Guthrie resigned the presidency of the Hillman Company two years ago because of ill health, but was chosen a vice president of the concern and was so serving at his death.

Born in Portsmouth, Ohio, Guthrie's interests in the early years of his career centered in Ohio's coal fields. From a minor office in a coal company he rose to the presidency of the Sunday Creek Coal Company and became president of the Republic Iron and Steel in charge of its mining properties in 1909 and served as such until 1911, when he went to Cleveland to direct the activities of the Standard Welding Company.

He was a director also of the First National Bank of Jerome, Pa., and of the National Coal Association.

WITH THE MANUFACTURERS

Goodman Buys Rock Springs Loader

Eugene McAliffe, president, announces the sale of the Rock Springs Loader Company, including the rights to manufacture and sell the well known Universal Shaker Loader, or "Duckbill," and the "MacHatson" conveyor trough fastener, to the Goodman Manufacturing Company of Chicago.

Requests for information regarding these valuable adjuncts to shaker conveyor equipment should be directed to the new owners.

Wind Tunnel Box Determines Efficiency of Fan Blades

This "wind tunnel box," set up in the East Pittsburgh works of the Westinghouse Electric and Manufacturing Company, finds by test the efficiency of various types of fan blades. The blades are designed on the "air wing" theory used successfully in the design of airplane propellers. When run at different speeds and under different loads they determine the best set of conditions for each particular purpose—whether the ventilation of mine shafts passageways like that of the Pennsylvania Railroad and the Holland vehicular tunnel under the Hudson River at New York City, as well as the ventilation of factories, office buildings, theaters, and the cooling of giant oil-electric locomotives.

In the illustration the engineer on the right keeps the fan at a constant speed during test by regulating the electricity supplied to the fan motor through the controller above the fan. Its speed is read directly from the speedometer in his left hand. The engineer in the center is reading the difference in pressure between the inside and outside of the "wind tunnel box." The observer on the left is measuring the amount of electricity consumed by the fan motor.

Inside the "box" is a series of baffles which can be moved forward and backward to increase or decrease the air pressure which varies the "pull" required by the fan.

Through series of computations based on these measurements, the efficiency of the fan blade is determined. The efficiency of certain types of fans has been increased nearly 50 percent by means of these tests and the "air wing" theory of design.

Efficiency test being run on fan blades in the Westinghouse wind tunnel box

Centrifugal Pumping Units

Allis-Chalmers Manufacturing Company, Milwaukee, has published a new bulletin (No. 1647) on the Type "SSU" centrifugal pumping units. The pump and motor described have been designed as a complete unit and not simply tied together by means of a coupling. To aid in the selection of a unit suited for specific needs, there is given a table showing the proper unit for different heads and capacities.

Segmental Carbon-free Crucibles for Induction Furnaces

After a year of successful development work in practical installations the Babcock & Wilcox Company are marketing built-up crucibles made of B. & W. No. 80 refractory material for use in induction furnaces for the melting of cast iron and special alloys. These crucibles are constructed of a number of tongued and grooved sections of tile, cemented together with B. & W. No. 80 cement. The crucible is set into the furnace coil, and the intermediate space between the coil and the crucible then packed with mica or asbestos paper. The inside of the crucible has a rammed lining of B. & W. No. 80 crucible cement. By repairing or renewing the cement lining every 10 to 15 melts it is possible to obtain 150 to 200 melts from one crucible—a striking contrast to a maximum life of approximately 10 melts total for other types of crucibles.

New Air Gap Hanger Restricts Formation of Conducting Deposit

As an addition to their extensive line of mine hangers, the Ohio Brass Company, Mansfield, Ohio, has announced a new K Type Air Gap Mine Hanger.

An air gap between the insulation and hanger shell provides additional leakage distance and thus appreciably raises the

wet flash-over value of the hanger. The gap also restricts the formation of any conducting deposit across the face of the insulator. This device is designed for direct attachment to the mine roof by means of an expansion bolt.

Hanger shells are made of Flecto Malleable Iron, hot-dip galvanized, with O-B Dirigo insulation permanently moulded in. The device is rated to operate on all currents up to 550 volts.

New G. E. Lubricant for Motors

The General Electric Company has announced a new grease for ball and roller bearing motors.

The grease embodies all necessary qualities for the proper lubrication of ball and roller bearings and is used in General Electric factories for the initial lubrication of all general purpose motors using these types of bearings. This lubricant is being successfully used on ball bearing application with speeds as high as 25,000 r. p. m. and temperature exposures from —25 degrees to 250 degreess F. However, its use is recommended only for the lubrication of motor bearings where the motors were originally grease lubricated.

The new lubricant is supplied in two-ounce tubes and one-pound cans. A tab-

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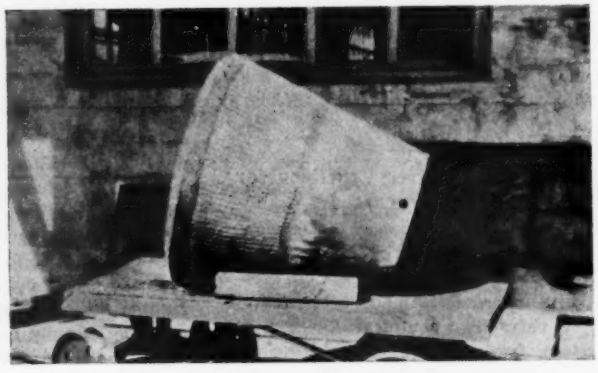
ulation appearing on the instruction sheet accompanying the two-ounce tube denotes the amount of grease used in the various motors by frame sizes. The tube is calibrated into one-half ounces and the cover of the one-pound can holds two ounces. This assists in measuring the amounts of grease recommended for the various bearings without weighing the lubricant. A removable instruction sheet printed on oil-proof paper, inserted in the cover of the can, provides a means of protecting this measure from an accumulation of dirt when not in use. Protection against the admission of abrasives is further guarded against by the use of a full opening friction top can which has no ring or groove around the top of the can to harbor such material.

Hascrome Prolongs Life of Gyratory Crusher Mantles

Recent tests by a mining company in northern California have shown the application of Hascrome welding rod to worn crusher mantles to be highly successful. The average life of a manganese steel mantle crushing copper pyrites was found to be approximately 6 months. At the end of this time the



A typical gyratory crusher mantle after an application of "Hascrome"

2½-in. thick metal is practically worn through. One of these castings was reclaimed after being taken out of service by building up the worn surface with Hascrome. Ninety pounds of this material was used, requiring 25 hours of labor to apply it. The total cost of rebuilding, including overhead, amounted to slightly more than 25 percent of the cost of a new mantle. At the end of 4 months this part, having crushed 28,000 tons of copper pyrites, showed but 5/32 in. of wear. It was again recoated and put back into service.

Another mantle, reclaimed with Hascrome, was examined at the end of three months. It has worn about ⅛-in. while crushing 21,000 tons of the same ore. This was also built up to the desired size and put on the job once more. Since then, this company has sent three more mantles to their shop for reclamation, which shows how convincing the results have been.

In the Salt Lake City district of Utah, a smelting and refining company built up a "two-piece" crusher mantle, using 125 lbs. of Hascrome. It was put in service in December, 1929, and is still in perfect condition. The saving over the cost of a new one in this case was practically 60 percent; and subsequent to the results obtained from the first casting, this company has adopted reclaiming with Hascrome as standard practice for all its gyratories. Had this mantle been of one-piece construction and of larger size, the percentage of saving due to reclamation instead of replacement would have been even higher.

Hascrome is a product of the Haynes Stellite Company.

General Electric Engineer Receives McGraw Award

Lee F. Adams, commercial engineer of the General Electric Company, at Schenectady, has been awarded the Manufacturers Medal and Purse for 1930, given under the James H. McGraw award. This recognition is the result of "outstanding and unselfish service to the manufacturing branch of the electrical industry."

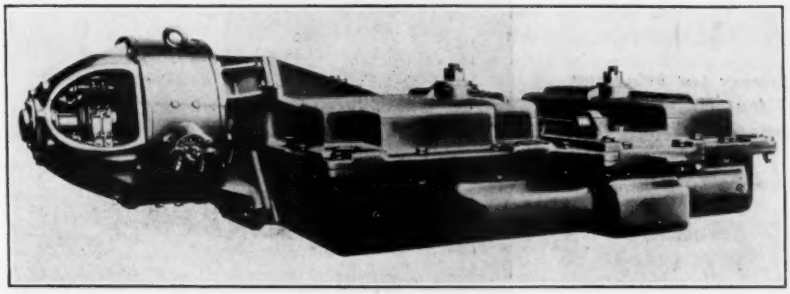
New Shaker Conveyor Drive by Conveyor Sales Company

A new shaker conveyor drive developed by the Conveyor Sales Company, Inc., of New York City, has overcome the difficulty of securing the proper relation between acceleration and retardation by the application of a new principle, with results that are decidedly interesting. The drive, known as the C-20, is primarily built for use in coal mines, but its field of usefulness is actually much wider, including sand and gravel, or crushed rock plants, power houses, etc. Outstanding features of the drive are its simplicity and its compactness. The overall dimension are: Height, 24¾ in.; width, 84½ in., plus from 20⅞ to 35 5/6 in. for the motor, and length, 44 in. The weight installed is 6,400 lbs. As a result, it can be installed practically regardless of space limitations.

The principle of operation is comparatively simple, but is so designed as to provide exactly the correct relation between acceleration velocity and that of retardation. The mechanism consists of a gear train and crossarm which convert the rotary motion of the motor into reciprocating motion of a crosshead, which is connected to the conveyor trough, with a minimum loss of energy. As a matter of fact, the drive required from 30 to 50 percent less power, and is 50 percent more efficient than the ordinary types. The mechanism is totally enclosed in a heavy cast steel case, which also serves as an oil reservoir, and is provided with three separate covers, so that access to any part of the mechanism is quite easy. Four sockets are cast into the top of the case for the reception of ratchet-holding jacks, and, since the drive straddles the conveyor, there are no twisting strains set upon the jacks that are likely to loosen them. The driving motor is bracket mounted, the necessary pads being cast integral with the case. Motors are rated 20 hp. and may be either d. c. or a. c., permissible or open, as required. Automatic remote control with time limit acceleration and full protection against overload and under voltage is provided for the motor.

The gears are made from heat-treated cast steel, with stub-cut teeth, and all shafts are mounted in Timken bearings, the mountings being such as to hold the various shafts in rigid alignment.

In operation the rotary motion of the gears is transposed into reciprocatory motion of the crosshead by the action of the crossarm working on the wrist pins in the gears. By virtue of the arrangement used, the peak velocity of the forward stroke comes beyond 120° of the



The new Conveyor Sales shaker conveyor drive

full revolution, and the peak of the reverse, or retarding stroke, before 240°, which is the ideal condition for drives of this type. Consequently there is no waste of power and no tendency for retrograde slipping of the material in the trough. The maximum length of the stroke is 11 in., but it is possible to adjust it quite simply by altering the angular relation of the wrist pin and shaft on one gear with that of the wrist pin and shaft on the other. Altogether 14 different strokes, between 11 in. and zero, are available for any setting of the drive; that is, whether it is running right or left handed with respect to the orientation of the motor side to the conveyor trough. Owing to its construction, the drive has considerable flexibility from an installation standpoint, which makes it particularly valuable in cases where space limitations of one sort or another are a determining factor in the situation. As in coal mines, for instance, where width of entries and brushing are important considerations.

Willard Dow Heads Chemical Plant

Willard H. Dow has been appointed president and general manager of the Dow Chemical Company, Midland, Mich., to succeed Dr. Herbert H. Dow, deceased.

For several years the organization which Mr. Dow heads experimented with the use of calcium chloride and other chemical products as a means of allaying coal dust. As a result of this experimental work, Koltreat calcium chloride, a highly deliquescent chemical, is now used as a coal dust preventive and freezing deterrent. While chemistry is far removed from the sale of coal, it has come to the fore with this greatly appreciated sales help.

For eight years Mr. Dow has been a member of the Board of Directors, and for the past four years he has acted as assistant general manager. For the last three years he has also been assistant treasurer.

PHANTOM RAILWAY OPERATING AT TEXAS CEMENT PLANT

The Trinity Portland cement plant at Dallas, Tex., has a railway on which cars transfer cement rock from the excavating pit to the crusher apparently without the direction of human beings. Nobody rides on the cars which move from place to place, starting and stopping here and there, as if possessed of an intelligence of their own.

This unique railway operates by means of special electric equipment manufactured by the General Electric Company, and is known as the "riderless larry car" system, a method of remote control devised by that company. Each car is equipped with two 50-horsepower, squirrel-cage motors with electric solenoid brakes and no other control devices of any kind. Power is collected from the track system. Two operators, located where they can view the loading and unloading of the cars and their movements, govern the principal car movements.

Cement rock, from which the cement is made, is excavated at this plant over a mile from the crusher. An inexpensive haulage system was needed and General Electric engineers were called upon to solve the problem. The "riderless larry car" system, previously applied by General Electric to another installation of a different type, was adapted for the purpose.

The track on which the cars run is divided into a number of sections insulated from each other. The motor-driven cars collect their energy from an extra rail system. Switches on control desks in front of the two operators control the delivery of energy to each section of track. By energizing all the sections, a car runs from one end of the track to the other. By energizing one section only, the car runs through that section to the next whereupon, the energy supply being cut off, the brakes automatically set and stop the car. Cars can be "inched" along, a short distance at a time, by applying energy to the section momentarily. Cars will not coast indefinitely on a dead track section because of the automatic action of the brakes. The direction of travel can be changed as simply as the current can be turned on or off—merely by throwing a switch.

Another interesting feature of the installation is the conservation of power made possible by the use of the squirrel-cage induction motors. An inherent characteristic of such motors is that they tend to maintain constant speed under all circumstances. On down grades gravity will not materially overspeed the cars but will be automatically converted into electricity, for the motors will then act as generators. The power thus generated will be fed back into the power system, helping to operate other cars on other sections of track.

The use of induction motors is new for such applications, direct-current motors usually being employed. The dump cars to which the electric drive is applied were built by the Atlas Car & Manufacturing Company.

The illustration on the left shows the operator at the control desk. Each of the switches before him controls a section of track; movement to one side controls forward movement, and movement to the other side reverses operation. When the switch is in a neutral position, power is off and brakes on. On the right is a view of one section of track, with one of the riderless cars in the foreground.

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Sullivan Machinery Company

New bulletins have recently been issued by the Sullivan Machinery Company, Chicago, descriptive of their latest types of rock drills, portable hoists, coal cutters and mine car air compressors.

Bulletin 87-D, Sullivan "L-6" rotator rock drill. The "L-6" rotator is a one-man drill, weighing 58 lbs. intended for all around service in conditions where a mounting is not required, such as bench drilling, shaft sinking, open cut work, quarrying, etc. The machine may be mounted by means of a cradle on a mining column for drifting, or on a tripod for deep hole work.

Bulletin 76-M, turbinair portable hoists. These turbinair hoists are built in a number of sizes and types, including single drum with 3 hp. and 7½ hp. motors, also double drum units for scraper loading and similar purposes.

Bulletin 76-L, Sullivan cathead, operated by compressed air or steam. This cathead, primarily introduced for service on oilfield drilling derricks, is adapted for a considerable range of handy uses in mining, construction, and general service, where loads can be handled with a loose rope in either hoisting or hauling work.

Bulletin 82-H, describes Sullivan ironclad coal undercutters of the chain feed type, for room and pillar mining—a product of over 35 years of progressive development.

Mine car air compressors of new design are covered in Bulletin 83-U. They include the "WK-22" 120-cu. ft., two cylinder vertical model, for mines of ordinary working height; the "WK-22" with two horizontal cylinders, for low vein conditions; and the "WK-44" 238-cu. ft., four-cylinder "V" type twin units.

New Screen for Coarse Scalping and Screening

Robins Conveying Belt Company announces a new screen, the Mogul Gyrex, designed and used for coarse scalping and screening. The manufacturers claim that it will not only screen out as large as 6-in. material but it will handle in the feed pieces ranging up to 20 in. This makes it adaptable as a scalping or screening unit for hand-mucked ore and to follow the primary crusher in both ore reduction mills and crushed stone plants.

Since the efficiency of secondary crushing depends so largely upon the absence of undersize in the feed, the Mogul screen is recommended as a scalping unit ahead of the secondary crushers.

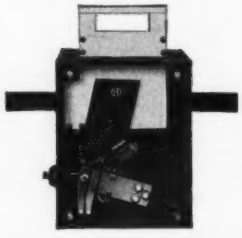
New Leahy Screen Bulletin

The Deister Concentrator Company, Ft. Wayne, Ind., has a new bulletin (No. 12-E) on the Leahy no-blind vibrating screen, presenting the kind of information that especially interests the operating man. Considerable attention is given to the theory underlying principles of the screening art. In addition, pictures throughout the bulletin aptly show methods of installation, some of which are out of the ordinary and therefore of unusual value to plant engineers, superintendents, and the mechanical department.

Circuit Breaker Switch Sustains Given Overload Over Definite Period of Time

Combining an ability to sustain a given overload for a definite period of time with complete protection to the machine in the event of a short circuit, the new O-B Time Limit Circuit Breaker Switch is finding a growing number of valuable applications to modern methods of mine operation.

Primarily a circuit breaker, this switch will kick out instantaneously when a short circuit occurs. There are, however, numerous operation conditions



existing in mines which actually represent overloads, but which are only of a temporary nature and do not endanger the machinery. These conditions are handled in an ingenious way by this new device.

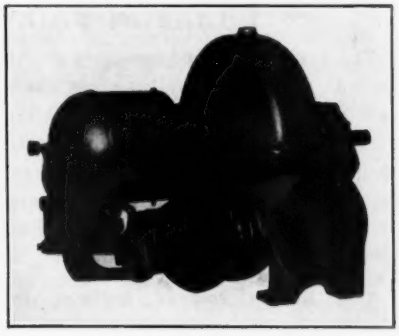
Overloads of a definite value may be sustained for any desired period of time from a few seconds to 20 minutes, depending upon the setting of a time element. Mine locomotives, for instance, may be protected by this circuit breaker by having it set to throw out just before dangerous overheating of the motors occurs. In this way full protection from short-circuit is always afforded, yet, at the same time, starting loads and other temporary excessive demands on the machine do not result in the breaker disconnecting.

Another extensive use for the O-B Time Limit Circuit Breaker Switch is that of setting it to sustain an overload for a period just within the time interval of the demand meter, arranging for it to throw out before this demand limit is exceeded.

This Time Limit Circuit Breaker Switch is one of several new safety control devices designed exclusively for mine service and manufactured by the Ohio Brass Company, Mansfield, Ohio.

New Mechanical-Drive Turbine Introduced by General Electric

A new small mechanical-drive noncondensing steam turbine for driving centrifugal pumps, fans and similar industrial equipment operating in general



at speeds between 1,750 and 3,600 r. p. m. has been announced by the General Electric Company.

The new turbine is built only as a single-stage machine and has two rows of revolving buckets. It follows the design of the standard line of G. E. mechanical-drive turbines and, although simple in construction, embodies dependability and reliability. The wheel casing is split horizontally for easy access to the internal parts, and the steam and exhaust pipes are connected to the lower half of the machine. A new centrifugal governor with weights pivoting on knife edges operates with very little friction and provides proper speed regulation. An independent emergency governor is included. The new turbine bears the type designation D-57.

Portable Belt Conveyor Folder Issued By Link-Belt

Link-Belt Company has just issued a folder, No. 1248, describing their "Cub" portable belt conveyor.

The contents of this folder contain a description of the machine, its parts, and gives a comprehensive list of the many industries in which this type machine has been used for handling various materials at low cost.

Illustrations of these machines at work under many conditions are shown, along with complete specifications of this loader—the "Cub."

CASH VALUE OF POWER LIMITING CHARACTERISTIC

THE capitalized value of the benefits conferred by the power limiting characteristic as found in *De Laval Centrifugal Pumps* may far exceed the first cost of the pump. They include:

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Motor driven De Laval pumps, 16,700 gal. per min. each against 390 ft. head at 720 R. P. M.

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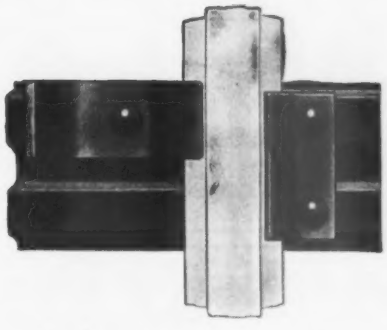

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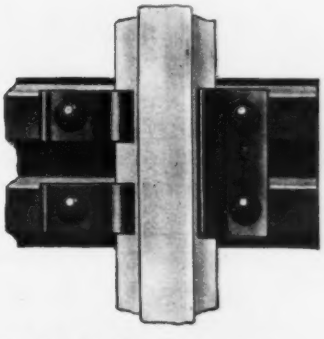

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Made with long self locking patented rotary clip.
A quarter turn of this clip locks the rail in place.
Furnished in 2 1-4"; 4"; 4 1-2" or 5 1-4" tie section.

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The double clip feature permits the use of this tie as a joint tie, each clip holding the end of the adjacent rail in place thus making a temporary joint.

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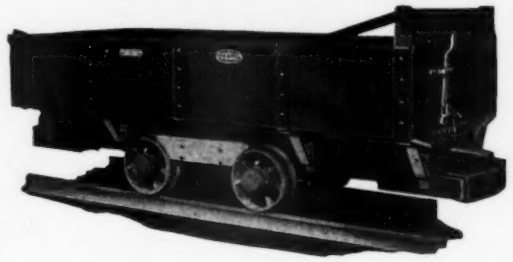

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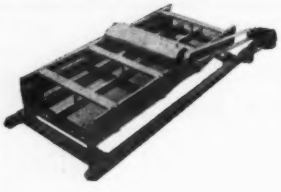

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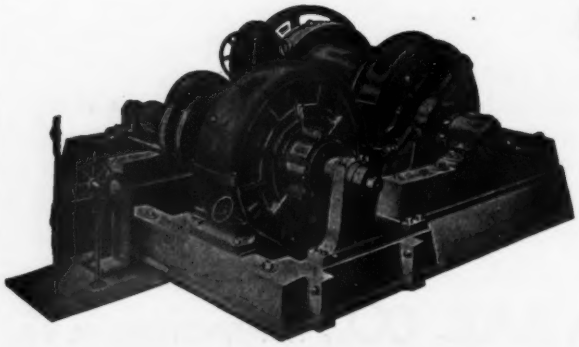

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RECENTLY at a mine at Vandergrift, Penna., Robinson engineers designed and installed a new fan in an old fan setting and changed the volume of air from 58,000 C.F.M. at 1.6" W.G. to 78,000 C.F.M. at 2.25" W.G. and are using only one 40 H.P. motor where two 40 H.P. motors were formerly required to drive the fan.

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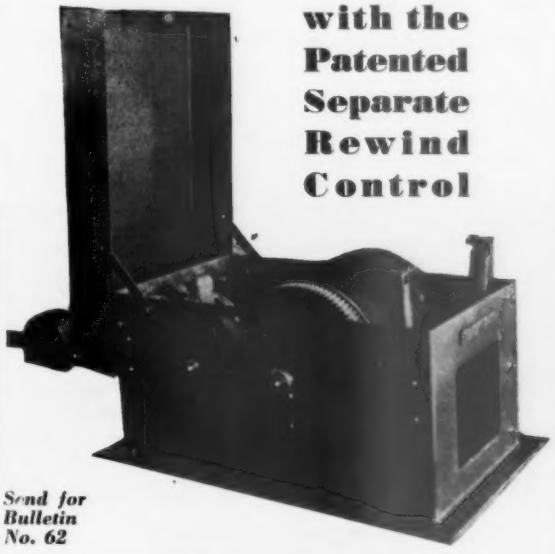

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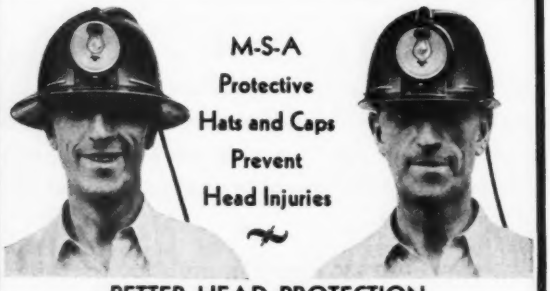

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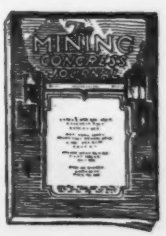
Nineteen *and* thirty-one one-hundredths

THINKING in centuries the thirty-second one-hundredth of the twentieth century seems fairly insignificant. In the terms of opportunity and in terms of business it is a new year. Three hundred and sixty-five days of new opportunities upon which to build. For us it means twelve more opportunities to increase our service to the mining industry. Briefly, we shall begin with an annual review number, outlined on the third cover of this issue. There will be five of the popular industry numbers featuring respectively large individual operations in each of the following branches: anthracite, copper, lead and zinc, bituminous coal, and iron ore. There will also be the annual coal exposition and the coal convention papers issues. We believe the next year will see our service growing in value and usefulness to every phase of mining. May the new year bring renewed prosperity to mining.



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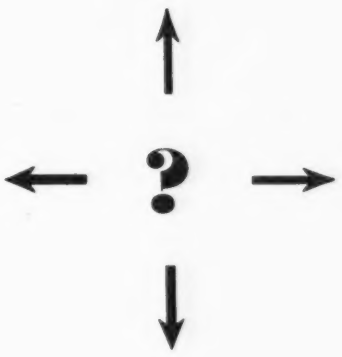

How far to PROSPERITY

THERE is some difference of opinion about its exact location but there IS real information to be had. The next issue of your Journal will bring expert observations from a number of those who have distinctive outlooks on mining horizons—the men in charge of or in close touch with the activities of the various mining organizations of the country. Sectional organizations, state organizations and separate industry organizations such as those representing iron, lead, zinc, copper and brass, manganese, anthracite and bituminous coal will contribute. Conditions will be reviewed and aggressive programs in force or planned will be described. This comparitive matching of notes will be most stimulating to every one in search of the State of Prosperity. In the January issue of The Mining Congress Journal.

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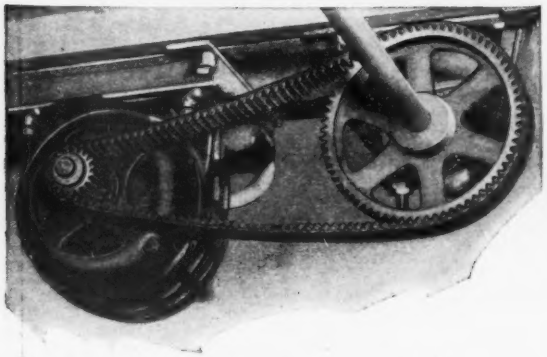
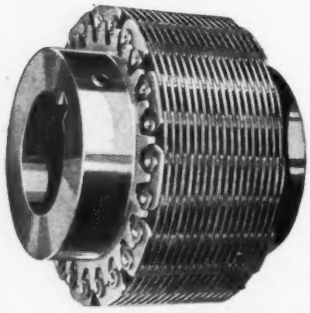
MORSE

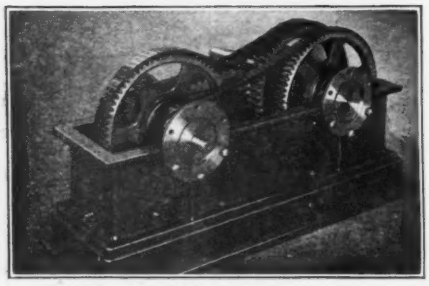
Power Transmission Service



Morse Silent Chain Drives



Morse Flexible Coupling



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